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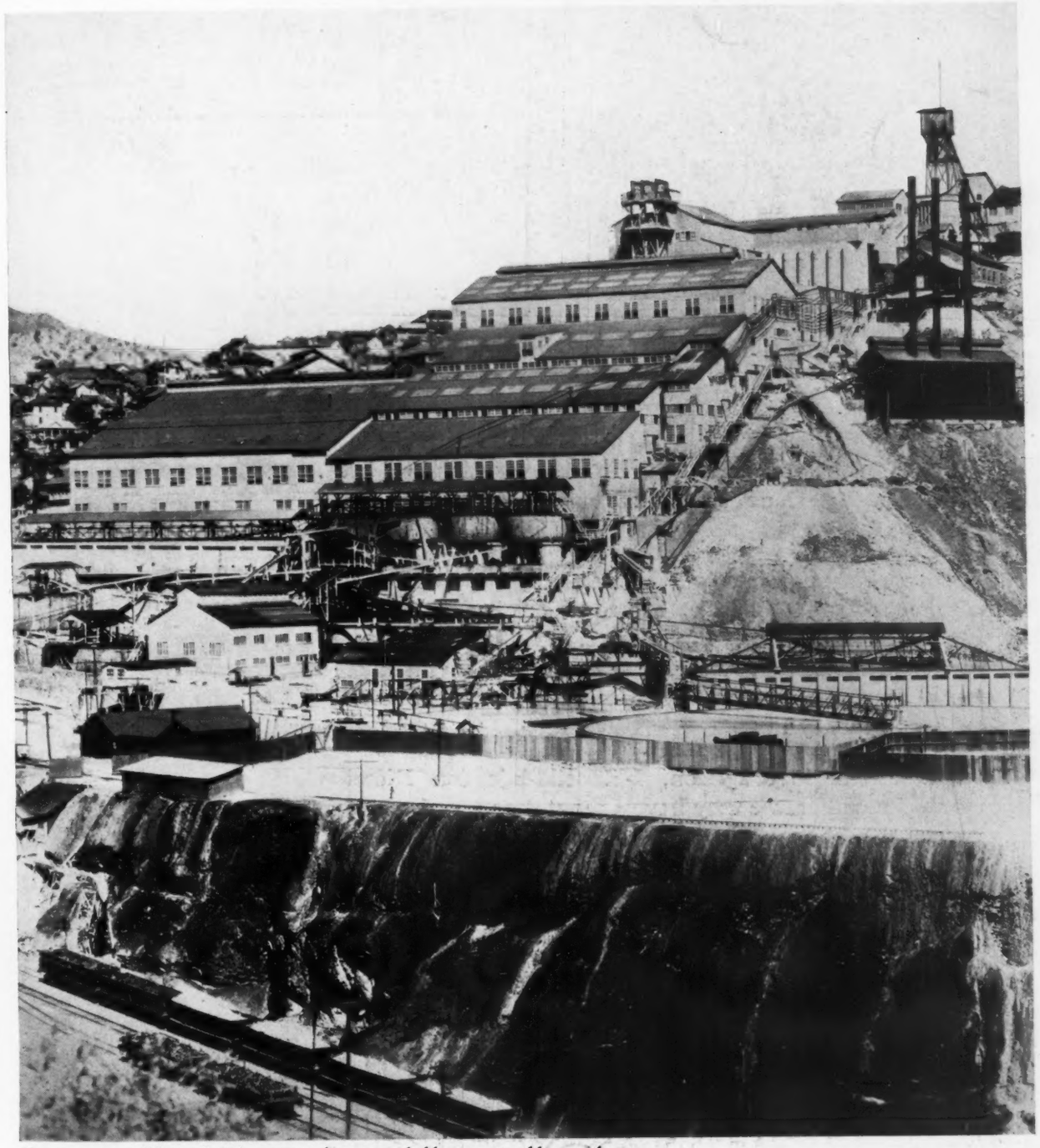

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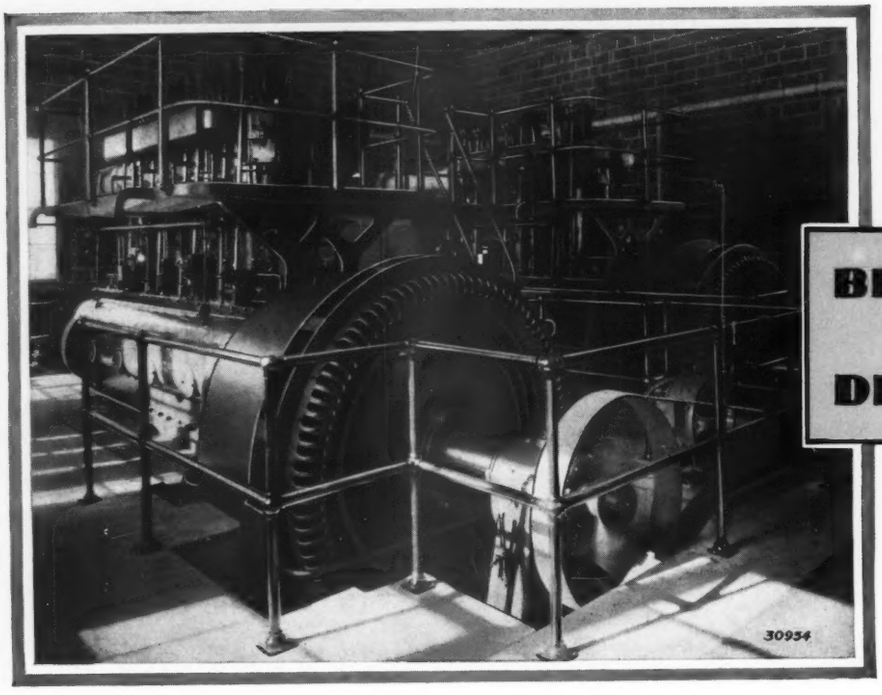
July 24, 1930



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ENGINEERING AND
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A. W. ALLEN, *Editor*

VOLUME 130, No. 2

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New York, July 24, 1930

Reliability of Standard Gold Assays

NEWS, like history, has a way of repeating itself. At intervals too long to permit the remembrance of details comes the startling announcement that the customary methods of assaying for gold are at fault—that gold ore contains more gold than is indicated by the standard assay—that vast losses are occurring because of the conservatism of assayers and their prejudices in favor of current methods of analysis.

Five years ago the credulous were startled by the report that the shales of Wyoming, Colorado, and Utah contained gold, silver, and platinum in commercial quantities. Claims were made by "a scholar of very high rank" that, by a new but undisclosed method, some highly encouraging results had been obtained on more than two hundred samples of oil shale. "Ninety per cent of the assays had shown a value in gold of from $4 to $45 per ton of shale; values in silver of from $2.50 to $16 per ton; values in platinum of from $4 per ton to more than $200 per ton. . . . *Laboratories that cannot recover these values simply acknowledge their own inefficiency,*" the profession was told. The italics are ours. But the "efficiency" of the new process was never demonstrated.

A few years later a variation of the old story came from Canada. A new process for the extraction of colloidal gold had been evolved. The metal was said to occur in a form neither amorphous nor crystalline. It was present, according to the account, in the form of minute particles, and "some claim that these particles cannot be found even by the best assaying. That some kind of additional gold exists other than in forms already known is admitted by almost all mine managers," the interested were told. The new process indicated that "there is at least $3 a ton of this 'colloidal gold' in almost all gold-bearing ores." In a short while this discovery was also relegated to the limbo of forgotten inventions. The statements were never substantiated, and the process was never applied on a commercial scale.

Now comes a recrudescence of the story—this time from Johannesburg—by cable to the Chicago *Daily News*. An Italian professor apparently sojourning there has discovered that "Gold assays made on the Witwatersrand are all wrong. . . . When chemists have assayed five or six pennyweights," claims the professor, "I will show how to realize sixty to seventy pennyweights. On one sample from a mine dump that assayed two-tenths of a pennyweight to the ton I realized 20.2 pennyweights." By a simple calculation the professor estimates the real value of the reserves on the Witwatersrand at three hundred thousand million dollars. The discovery, we are solemnly assured by the Chicago paper, "may have a serious effect on the gold standard."

Too many scare reports of this character have appeared to justify any weakening of confidence in the ability of the competent assayer. Incidents in the colorful history of alchemy recur at intervals. They will continue to recur. Gullible individuals are still to be found, in every country, in every walk of life.

Licensing of Engineers Meets Difficulties in California

ENGINEERS in California, especially mining engineers, are puzzled as to their status with respect to the licensing act recently established in that state, supposed to apply solely to civil engineers. The Board of Registration for civil engineers established under this enactment has sent copies of application blanks to civil, mining, mechanical, and other kinds of engineers. So far as mining engineers are concerned, many whose activities appear to overlap the field of the civil engineer, as well as some whose work does not, are in a quandary as to their course of action. Some have decided to pay the $15 registration fee; others have decided to ignore the matter.

The Board of Registration in its attempt to administer the law has defined civil engineering, but in such a comprehensive way as to overlap part of the work of the mining engineer. The definition of any one kind of engineering without intruding on any other branch of engineering is obviously impossible. All deal with economics, with the laws, phenomena, and forces of nature, as well as with various kinds of structures. Until the courts define specifically the limitations of civil engineering, as well as the limitations of other branches of engineering, the status of some engineers will be in doubt. Economic exigencies have caused many mining engineers to enter fields of work remote from their calling, with conspicuously successful results.

A civil engineer who has specialized in irrigation work and who registers as a civil engineer is not thereby barred from practicing other civil engineering specialties. A mining engineer who has had fundamental training and practice in mining engineering, and who is competent to expand his activities into other allied fields outlined by the Board of Registration, cannot do so unless he submits to examination and secures registration.

Scope and initiative are restricted by legislation of this kind. Whether or not a commensurate gain to the community results by such restriction is highly debatable.

Acquiring a Liberal Technical Education

BENEFITS invariably accrue from the interchange of equipment between the various branches of metallurgy and chemical engineering. The non-ferrous metallurgist who is alert and watchful constantly receives new ideas from unexpected sources. From the steel industry he borrowed the bessemer converter, which in a short time revolutionized the metallurgy of copper and nickel. The open-hearth furnace has found its parallel in the reverberatory furnace, which still proves its worth in the treatment of the high-grade concentrate from the modern mill. The mercury-arc rectifier, long used in the electric railway industry, is finding application in hydrometallurgy; and the engineers to whom this innovation may be credited already see indications of economies and improved operating results.

The Waelz process, which is described elsewhere in this issue, is another recent example of inter-process utilization. Although designed for unlike purposes and exhibiting striking differences in essential operating details, many similarities exist between the Waelz process and the customary method of manufacturing portland cement. The engineers responsible for the Waelz process undoubtedly, judging by results achieved, benefited by a study of successful practice in the cement industry.

Examples such as those cited indicate the value of a broad general knowledge. Carried to an extreme, specialization in school and college, and in the early years of professional work, may lead to the development of a narrow viewpoint and to one-channel thinking. Catholicity as well as specialized knowledge is needed in the acquiring of a liberal technical education. To acquaint oneself, even superficially, with the work that others are doing in allied fields of endeavor is to increase the sum total of useful general knowledge. This type of education does not fall under the strictures of the poet who decried "a little learning," but who is invariably quoted as disparaging the acquisition of knowledge in small doses.

Opportunity for Putting the Plant in Order

NOW is the time when the management of a mining company has a chance to show its ability to manage. Will it shut down, or will it seize the opportunity to prepare for better days? At times like these the weak-nerved executive is prone to get that hollow, "gone" feeling, which, when analyzed, is found to be merely fear—the desire to quit. Experience, if he has had it, should tell him that dull times have their advantages. Booms never last; and well it is they do not. Only the average counts in the long stretch. When the pace slows down, as it has at the moment, conditions are much better for making alterations, replacements, and repairs.

"Any good business man," writes a well-known executive, "has confidence in himself, his business, and its future, and recognizes the wisdom of making repairs and renewals at a time when the demands upon his equipment are less urgent than they normally are." Done at a busier time, such repairs will increase production cost, and the resultant expenditure will be greater than if improvements and replacements were made when operations are subnormal.

Sooner or later the run-down plant must be rehabilitated. Perhaps it will operate a little while longer as it is, but a study of cost sheets will show that expenses mount because of breakdowns, consequent lost time, and other causes. Labor is now plentiful, and perhaps nervous about its job. Later, when conditions improve, this condition will probably be changed. Now is the time for putting the plant in order. Periods of depression, like booms, do not last forever. Operators who seize the present breathing spell to make equipment shipshape and to prepare for maximum efficiency when conditions improve will be glad later on.

There Is Still Gold in Georgia

THE gold deposits of the State of Georgia resemble a perennial flowering plant that never blooms. Hardly a year goes by without reports of plans to work the placers or the vein systems of McDuffie or Lumpkin counties, but actual accomplishment in adding to the gold production of the country seems difficult to achieve. The chief argument used to attract capital is that the southern Appalachians once witnessed a prosperous gold-producing industry, but that the miners left for California in 1849, where fabulous riches were to be won, and never came back. The sporadic attempts to mine gold ore in Georgia since that time have been doomed to failure from the start, owing to lack of sufficient capital and the absence of a spirit of metallurgical initiative and courage similar to that which has inspired the copper industry in the handling of its low-grade ores.

Between 1799 and 1926 the State of Georgia produced about eighteen million dollars' worth of gold, according to the United States Bureau of Mines, but during and since the World War the industry has been virtually dormant. As an indication of the scale of operations in recent years, the state produced gold worth about $3,000 in 1926, from three placers and three so-called deep-level mines. The total output of the state in 1929 was only 58 ounces.

Attention has been directed to this matter by the receipt of a circular emanating from Fort Worth, Texas, entitled "The Rich Placer Deposits of Georgia." The writer begins thus: "I found that she has some of the richest placer deposits in the United States, and that there are millions of dollars in gold lying along the Georgia Gold Belt, and a great amount of these gold-bearing lands will run from $1 to $2 per cubic yard. And I found the gold is of the highest in value, bringing $20 per ounce. I found that there was but little known and less written of the Georgia gold deposits than of any other mineral district in America, and that very few people seemed to know that the first United States mint was located in Georgia, and I found that about six million dollars in gold had passed through this mint, and I found that two counties had produced sixty million dollars in gold, and but very little of this going through the mint.

. . . I found that these rich placer deposits can be worked either by dredging, hydraulic or slussing [sic], the cost being only a few cents per yard. I found all the Georgia gold coarse and needs no quicksilver to hold it, and the overburden is made up of a loam soil and will wash away like sugar." And so on, winding up with the great opportunity: "I have some rich deposits on the mother land of Georgia that can be bought reasonable."

One would not be greatly impressed with the possibilities, based upon a reading of this circular, but gold does exist in Georgia, apparently in large tonnages of low-grade ore. An opportunity may develop for a profitable enterprise, but the venture must be tackled in the same spirit and with the same determination that changed Chuquicamata from a mountain of discolored stone into one of the greatest copper mines in the world. The future of Georgia as a gold producer will depend to a large extent on the attitude of the owners of the prospects, who should realize that successful exploitation can be brought about only by large capital expenditures for research and development, involving no small degree of financial hazard.

Progress to Which We Can Look Forward

SO MUCH has been accomplished toward furthering the luxury of living in the last three decades that some persons find it difficult to forecast what the immediate future may have in store. Television may be definitely counted on, apparently, before long; efforts to abate noise are making progress; improved roads may temper the punishment suffered by the Sunday afternoon motorist; and an increasing proportion of the population of all nations is likely in the future to travel in the air, even more comfortably and expeditiously than on the ground. But less thought is given to an improvement that has been concisely termed "manufactured weather."

Workers in deep mines, where humidity and temperature become almost unbearable at great depth unless ameliorative measures are used, have been among the first to be accorded benefit, but the measures usually employed there have been relatively simple, consisting mostly in increased ventilation by surface air. Moving-picture theaters recently adopted more effective measures on a large scale to relieve discomfort, processing the air supplied to the auditoriums, cooling it, cleaning it, and removing excess moisture. Macy's department store, in New York, adopted last summer this innovation for its basement and first floor, to the relief of customers and the stimulation of sales. More recently, the Baltimore & Ohio Railroad has equipped one of its dining cars with an air-conditioning system, to assure the comfort of passengers in disagreeably hot or muggy weather.

Perhaps no present development would do more to add to human comfort than a wide extension and development of this idea. Is it not as sensible to take steps to keep cool in summer as to keep warm in winter? It may not appear so necessary, because the difference between seventy and ninety degrees is less than between seventy and thirty. Clothing of the proper character will conserve heat and bring comfort to the wearer within a wide temperature range. Maximum permissible discarding of apparel, however, in places where the air is hot and humid and stagnant will afford negligible relief.

Manufactured weather should be applied to places where large numbers of persons congregate, or where arduous work, mental or physical, must be performed. In time, one may expect that even the modest home will be made comfortable on the hottest summer day; the refrigerator in the kitchen will be supplemented by a cooling and air-conditioning plant in the basement.

Opportunities for New Silver Alloys

REGARDING the future possibilities of silver, Professor Dr. W. Guertler, of Berlin, suggests in *Metallwirtschaft* that metals other than copper be used as additions in the production of sterling silver. Most countries have laws stipulating the minimum amount of silver required in articles bearing the official stamp or hallmark of sterling silver, fine silver, or genuine silver. Copper is by far the most common addition, but the use of the metal thus is based more on custom than on merit. Modern alloy technique has demonstrated that other metals may prove more suitable. Such metals, although less noble than copper, influence the chemical qualities of the silver less than do equal or even small additions of copper. Zinc and cadmium, for instance, can be added in far larger amounts than 20 per cent—the maximum amount allowed in Germany—without materially decreasing the noble qualities of the silver.

Tin, antimony, manganese, aluminum and magnesium have proved valuable as additions to silver. The platinum metals are available if extra-noble qualities are required. Thus, an infinite variety of alloys may be developed, which possess, in addition to the chemical resistance of the silver, the physical characteristics of bronze or steel. Alloys can be made that are well adapted for the manufacture of useful and ornamental articles, for which a ready market could be developed.

In the efforts to improve the unfavorable status of silver, no possibility should be left unexploited. Serious objections to the use of silver, among which its tendency to tarnish probably comes first, and its lack of desirable physical characteristics second, must be overcome. Solution to both these problems may lie in the correct choice of alloying metals. Conservatism and reluctance to change styles on the part of the buying public will present no serious obstacle. The change in recent years in the character and composition of the gold used by jewelers—the replacement of the old reddish gold by yellow, green, or white gold—was accomplished without great effort. In fact, the constant craving of the public for something new and different may stimulate rather than retard trade.

THE WAELZ PROCESS

FROM Germany comes another outstanding development in metallurgy, offering a wide variety of applications in the recovery of metals. The Waelz process is especially interesting because it offers a solution for treatment of low-grade materials not amenable to former methods of extraction. The process, developed by Krupp's engineers, is protected by patents owned jointly by Krupp and Metallgesellschaft.

B. H. Strom

Editorial Staff

THE Waelz process introduces the rotary kiln into metallurgy for the recovery of volatile metals such as lead, zinc, cadmium, tin, bismuth, arsenic, and antimony. Up to the present time, however, its chief application has been for the recovery of zinc and lead. The rotary kiln was originally developed by the portland-cement industry, and the two processes have many points in common. The name of the process is derived from the German word *waelzen,* meaning the state of revolving or trundling, and it refers to the peculiar motion of the charge in the furnace. For the treatment of low-grade materials that cannot be concentrated profitably, and products containing impurities prohibiting wet methods of treatment, the process is exceedingly well adapted. The process opens up the possibility of recovering metal from residues, old slag dumps, tailings and middlings, and other byproducts formerly of little or no value, thus extracting profits from yesterday's waste.

Research and development work was started in 1923. In 1925, the first large installation was put in operation. Since that time rapid progress has been made, with 31 furnaces in actual operation at the present time, and several under construction. With the exception of one furnace treating tin ore, all installations handle zinc-lead products, and only this phase will be discussed herein. Two plants have been built in the United States, one by U. S. Steel at Donora, Pa., and the other by New Jersey Zinc at Palmerton, Pa. A graphic illustration of the growth of the process is presented in the accompanying diagram, giving tons of kiln capacity installed and in course of construction.

Extensive preliminary preparation of the material, such as briquetting, drying, roasting, or calcining, is not necessary. Water and carbon dioxide are said to be beneficial in the process, and sulphides are decomposed without formation of harmful sulphurous gases. This circumstance, combined with the flexibility of the process, its adaptability to a multiplicity of ores and metallurgical products. and its low operating cost are the chief reasons for its success. Charges containing as much as 40 per cent moisture have been handled successfully without appreciable increase in fuel consumption, as the heat contained in the escaping gases is sufficient to expel all water. Coal dust, coke breeze, coal screenings and washings, and other cheap grades of coal are used for reduction. The charge must be reduced to at least half-inch size, but is generally crushed to $\frac{1}{8}$ to $\frac{1}{16}$ in. (3 to 1.5 mm.). Finer material, even slime, may, however, be treated without difficulties of any kind.

Description of the Operation

A revolving kiln of the cement-kiln type, with a slope of 2 to 4 deg. (2 to 6 per cent) is used in the process. The charge, added at the upper end, is carried through the kiln by its rotating motion and discharged at the lower end. By varying the speed of the kiln the flow may be regulated to meet any specific condition. In most cases the charge is "self-burning." The heat of the reactions involved is sufficient to maintain the desired temperature, so that external heat is required only for starting the kiln and for taking care of

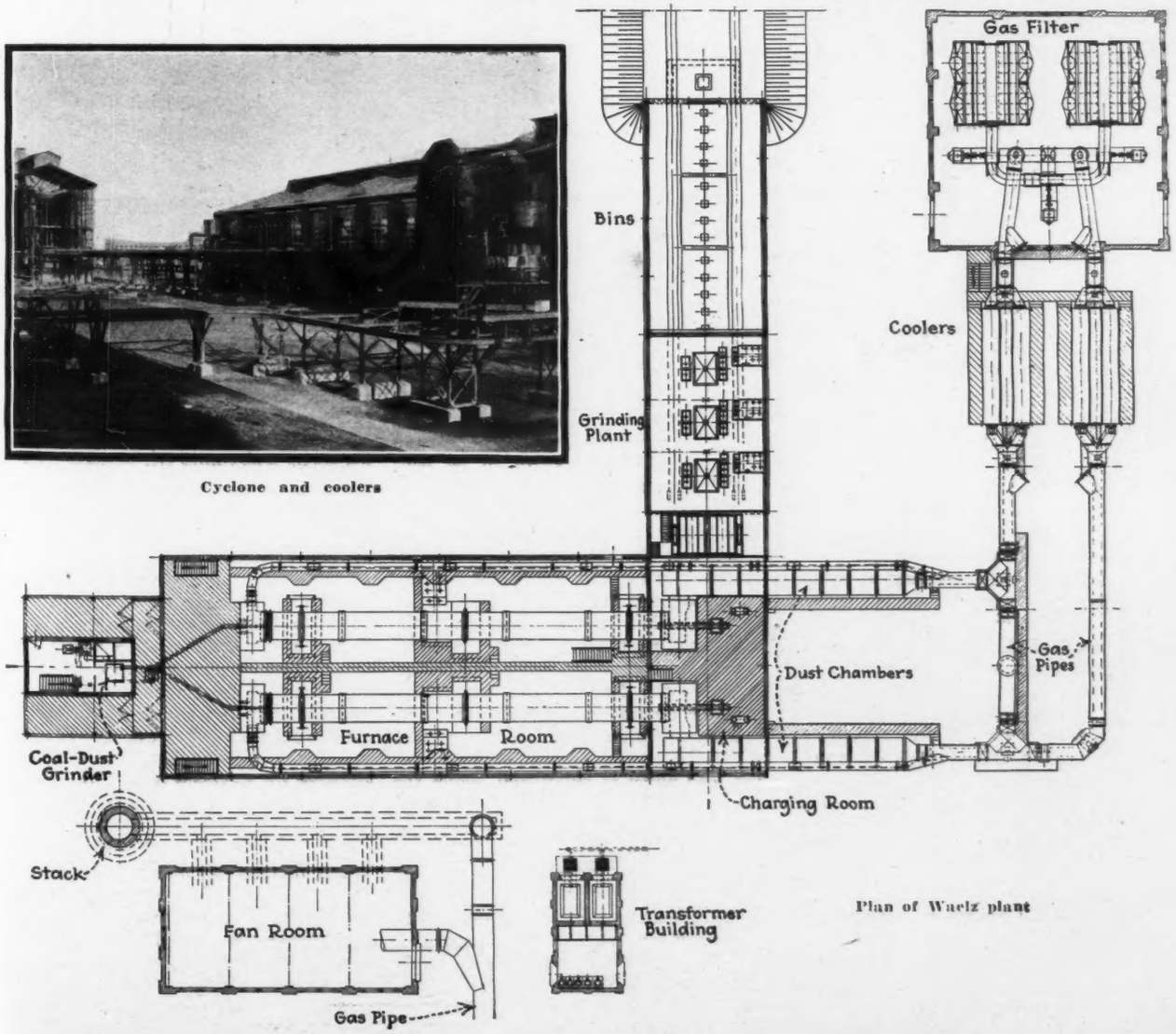
certain emergencies that may arise during the operation. An auxiliary burner for this purpose is placed at the discharge end of the kiln. As the charge enters the kiln, and meets the hot gases flowing in the opposite direction, the water is first driven out, and the material is then gradually heated to the point where the reduction of zinc takes place. The chemical reactions involved are simple. Zinc oxide is reduced by the free carbon in the charge, forming metallic zinc and carbon monoxide. At the existing temperature, however, the liberated zinc is volatilized and expelled as zinc vapor, which immediately is ignited by the oxidizing furnace gases and burned directly above the charge, forming finely divided zinc oxide. The carbon monoxide at the same time is oxidized to dioxide. The sum of all reactions leaves the exothermic oxidation of the carbon in the charge to carbon dioxide. These reactions may easily be observed in the kiln. In the zone of volatilization, small flames, colored green by the burning zinc, appear immediately above the charge. Toward the discharge end the flames become less evident, and the color gradually disappears until the yellow flame of burning carbon indicates where the volatilization of the zinc has ceased. The yellow flame is a good indication that the zinc has been completely expelled. With correct operation the escaping gases contain less than 1 per cent free oxygen, from a trace to 2 per cent carbon monoxide, and 18 per cent carbon dioxide, or more where the charge contains limestone or other carbonates. In the treatment of sulphide ores, lime is added to combine with the sulphur, according to the following reaction:

$$ZnS + CaO + C = Zn + CaS + CO$$

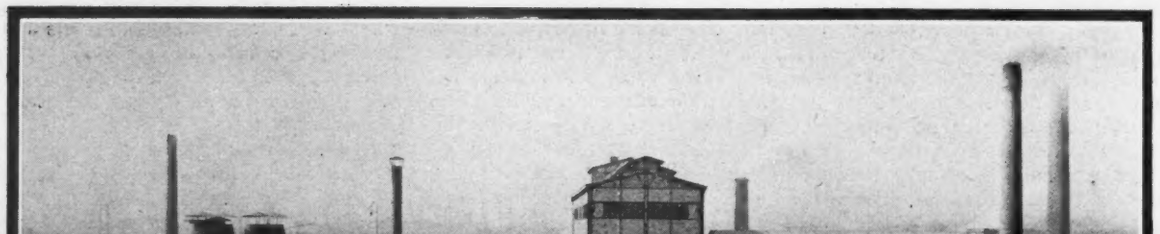
On account of the strongly reducing condition no oxidation of the sulphur takes place, the discharging gases generally analyzing less than 0.1 per cent cent SO_2, an amount not considered harmful. Lime may also be added to promote other chemical reactions; for instance, to combine with the acid constituents of the charge, thus setting free the metallic components and facilitating their reduction and volatilization. Where the charge has a low melting point, the addition of lime as a stiffening agent aids in preventing premature melting or sintering, which would cause mechanical disturbances and reduce the recovery. The reactions given for zinc also apply to the other volatile metals, such as lead, cadmium, or tin.

Drying and preheating take place in the upper third part of the kiln. When the temperature of the charge reaches about 1,000 deg. C., the reduction and volatilization become marked, and the temperature of the volatilization zone may rise as high as 1,300 deg. C. With this high temperature and the long time of reaction all oxide compounds of zinc are reduced, even silicates and ferrites, and the recovery is consequently high, generally over 95 per cent. Under normal conditions the charge remains in the kiln for about two hours, but this time may be varied by regulating the speed of rotation. Sintering and fusion must not occur, because this would decrease the volatilization and also lead to serious mechanical difficulties. The carbon content of the charge is normally between 25 and 30 per cent, and this high carbon content allows regulation of the kiln temperature by increasing or re-

Cyclone and coolers



Plan of Waelz plant



Waelz plant at Mansfeld

Dust chambers and coolers

ducing the draft. Use of the auxiliary burner is generally confined to the adjustment of other conditions than the temperature; as, for instance, to regulate the zone of volatilization to its proper place. Preheating of the draft has also been applied, but has not gained general use, as the heat evolved by the reactions is most frequently adequate for maintaining the temperature required in the kiln.

The Krupp's formula gives a capacity of 50 to 60 lb. per 24 hours per cubic foot of kiln space (0.8 to 1.0 metric ton per cubic meter). Kilns are built for as large an output as 400 tons per 24 hours, which appears to be the limit. The operation is easily made mechanical, and the labor requirement is small, one man being able to take care of a kiln, with the aid of a helper in large installations.

An even feed and a good mixture of the charge being essential, weighing and mixing should be carried out with great care, and thoughtful planning of bunker equipment is necessary where the feed is of a variable character. Power consumption, including conveying devices within the plant, varies between 18 and 30 kw.-hr. per ton of material treated, according to the size of the installation and the amount of crushing and grinding required in the preparation of the charge.

After leaving the kiln the gases are passed through a chamber, where the coarse flue dust is allowed to settle out. and then through suitable cooling equipment to a baghouse or Cottrell treaters, where the metal oxides are collected. A slight draft is maintained in the system by means of a fan, placed before or after the dust collector. The flue dust is generally returned to the feed end of the kiln by screw conveyors, frequently operating automatically. Oxide of high metal content is produced, containing 70 to 75 per cent zinc plus lead, but rarely of sufficient purity to be used directly by paint or rubber manufacturers, and it is therefore given further treatment in an electrolytic plant or a retort smelter. When the oxide is treated in an electrolytic plant no separation of lead and zinc is required, as the lead is left in the residue from the leaching process, from which it is easily recovered. If treated in a retort smelter, however, the lead if present in appreciable quantities is first removed by treatment of the mixed oxides in a kiln, where the temperature is kept so low that lead alone is volatilized, while the zinc oxide is left in a sintered state, well suited for retort treatment. If the lead content of the original charge is high—5 per cent or more—the kiln may be run at a low temperature in the first instance, producing lead oxide only, with subsequent treatment of the residue in a second kiln at a temperature sufficiently high to volatilize the zinc. Charges containing 10 to 15 per cent lead, as oxide, cannot be successfully treated, as such a high lead content would cause premature sintering, and thus prevent a satisfactory recovery. Lead-bearing materials containing the greater part of the lead as sulphide or sulphate, however, have been treated successfully by the Waelz process, even with a lead content as high as 30 per cent. About 70 per cent of the silver is volatilized, when the charge contains no sulphur. In the opposite case the silver, retained in the kiln discharge as a matte, may be recovered by magnetic separation of this matte, if the amount is sufficient to warrant such a procedure. Gold generally remains in the residue. Addition of chloride to the charge opens up possibilities for recovery of precious metals, but this method has not yet been exploited on a commercial scale.

An interesting application of the Waelz process has been made by Mansfeld A.G. für Bergbau und Hüttenbetrieb in Hettstedt, Saxony, where a lead-zinc slag is treated. This slag, produced by blast-furnace treatment of flue dust from the company's copper smelter, averages 18 per cent zinc, 1 to 2 per cent lead, 16 to 18 per cent silica, 30 to

40 per cent ferrous oxide, and 6 to 8 per cent sulphur. Current production of slag is about 18,000 tons per annum, in addition to which an equal tonnage from an old slag dump is treated. The slag is granulated to save crushing expenses and then ground in three Krupp ball mills (No. 6), mixed with coke breeze, and fed to the kiln with a push feeder and shaking conveyor of the Marcus type. Two kilns are used, 98 ft. (30 m.) long, 6½ ft. (2 m.) outside and 5¼ ft. (1.6 m.) inside diameter, supported at three bearing points, and having a speed of rotation ranging from 36 to 70 seconds per revolution, with six different steps, 55 seconds being the normal speed. The bearings of the supporting rollers are lubricated by scoop-type lubrication. The toothed driving rim is placed in the middle of the kiln and driven directly from the motor by a friction drive. In case of interruption in the power supply, a Gall chain may be put on in a short time and two men can keep the kiln slowly rotating to prevent damage to the shell. Direct current is used for the motor driving the kiln to allow close adjustment of the speed of rotation. The suction fans are also operated by direct-current motors to allow adjustment within wide limits. Ball mills, elevators, shaft lines for the kiln feed, conveyors, the coal-grinding mill, the vacuum pump for the pneumatic conveying of the oxide, and the worm for bagging are all run by alternating current. The front part of the Marcus conveyor used for feeding the kiln consists of flat-rolled tubes forming longitudinally extended water compartments. These chutes make 90 percussions per minute, and the consumption of cooling water for each of them is 140 cu.ft. (4 cu.m.) per hour.

The gases from the kiln pass through a dust chamber, where a low-grade flue dust, 3 to 4 per cent of the slag and containing about 13 per cent zinc, settles out and is returned automatically to the feed end of the kiln by a screw conveyor. As the gas contains no moisture or sulphur trioxide, and as the oxide, on account of its low sulphur content, is not pyrophoric, a baghouse is used for collecting it, an automatic filter built by Intensiv Filter Gesellschaft, Barmen, Germany, consisting of four sections, each having eight chambers with fourteen bags, a total of 448 bags, divided into two units, one for each kiln, each with a filter area of 5,000 sq.ft. (465 sq.m.). Gas volume in the kiln, reduced to 0 deg. C. and atmospheric pressure, varies between 1,000 and 2,000 cu.ft. (30 to 60 cu.m.) per minute, but fresh air is introduced into the gas as it leaves the kiln, so that the volume of the gas at the entrance of the filter plant is 8,000 to 12,000 cu.ft. (200 to 300 cu.m.) per minute, also reduced to standard conditions, at a temperature of 120 deg. C., giving a filter capacity of 0.5 sq.ft. per cubic foot of gas per minute. About twenty bags are replaced per month. The Intensiv filter requires closer supervision than an ordinary baghouse, but is giving satisfactory service. A pneumatic conveyor is used to transport the oxide, operated by an electrically driven dry vacuum pump manufactured by Amme Luther Works, of Brunswick, which has a capacity of 1,100 cu.ft. free air per minute (32 cu.m.). One cubic foot of air is required for the conveyance of 0.1 lb. oxide, which is equivalent to 1 cu.m. per 1.56 kg. of oxide. The power consumption for this installation is 35 kw.

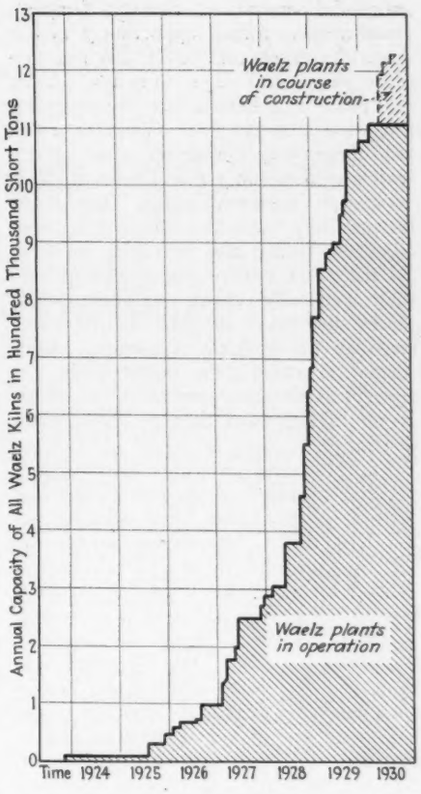
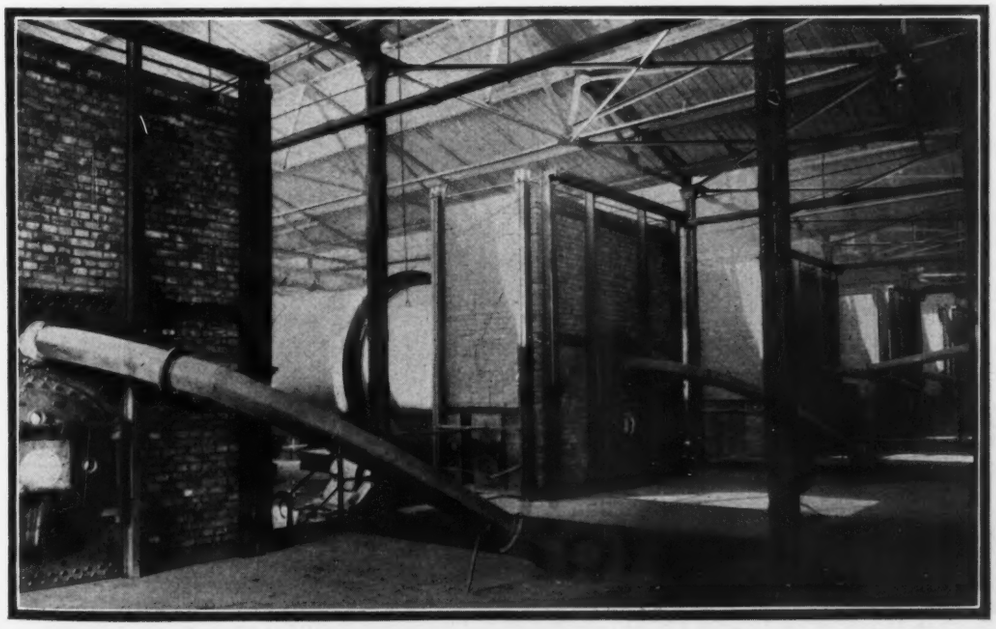


Diagram showing development of Waelz process

Over a twelve-month period the following results were obtained: Slag treated, 33,700 metric tons, an average of 51 tons per actual working day. Estimated capacity was 40 tons slag and 20 tons lime. Production of oxide was 8,120 tons, or 24 per cent of the slag by weight, analyzing 65 to 68 per cent zinc, 7 to 9 per cent lead, 1 per cent sulphur, and 0.12 per cent chlorine. Zinc in the kiln discharge varied between 1 and 3 per cent, representing 11 per cent of the total zinc content treated, which, in addition to 3.6 per cent unaccountable losses, gave an over-all recovery of 85.4



Fireboxes

per cent, a figure that, low compared with most Waelz plants, resulted from the low melting point of the slag, necessitating a low kiln temperature, as will be discussed later. Cost of operation for the year was 10.14 marks per ton of slag treated, or 42.08 marks per ton of oxide, not including filter cost, which was 1.06 marks per ton of slag, or 4.40 marks per ton of oxide, and exclusive of overhead charges and the price of the slag, which was delivered to the plant in a granulated state. These figures apply to the Mansfeld operation only and may differ for other plants according to local conditions.

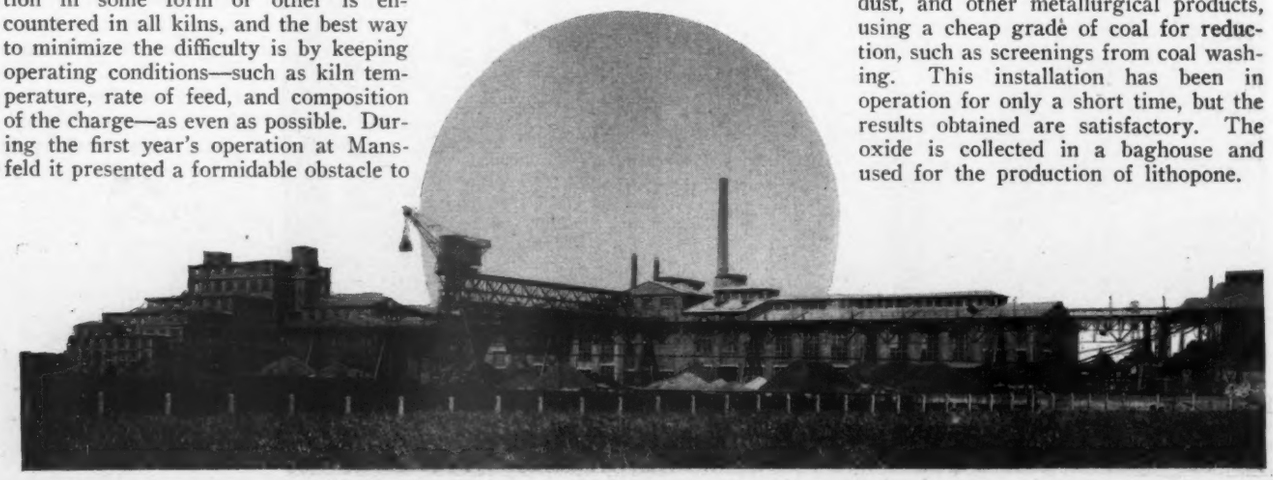
During the first period of operation the formation of annular crusts or rings on the lining of the kiln was a constant source of trouble. These accretions are not evenly distributed throughout the entire length of the kiln, but are formed principally in three distinct locations, between which the lining wears down thin, leaving the crusts or rings protruding. Such accretions reduce the capacity of the kiln and cause considerable difficulties in operation. In Mansfeld the condition is aggravated by the formation of liquid matte in the kiln, which collects in large pools behind the rings and destroys the lining in a short time. Three types of rings are formed, one in the upper part of the kiln, a second in the central section, and the third near the discharge end. The following explanation is given for this phenomenon: As the charge enters the kiln the lighter coke tends to segregate and roll ahead, leaving the heavier slag behind. Reaching the hot part of the kiln, the slag becomes soft, and, with the larger part of the coke removed, tends to agglomerate and stick to the lining. The second ring, in the central section of the kiln, where a large excess of coke is present, and where maximum temperature is reached, is an agglomeration of iron sulphide with a large percentage of dissolved metallic iron. Formation of the third ring takes place near the discharge end of the kiln at the point where the cold draft hits the lining and cools it off, making the hot discharge adhere to the cold lining. Ring formation in some form or other is encountered in all kilns, and the best way to minimize the difficulty is by keeping operating conditions—such as kiln temperature, rate of feed, and composition of the charge—as even as possible. During the first year's operation at Mansfeld it presented a formidable obstacle to successful operation, causing frequent shutdowns to afford opportunity to bar down the crusts and repair the lining—often of several days' duration. Now the rings are burned out by stopping the feed, charging an excess of coke, and increasing the draft, a procedure which requires only a few hours and involves no strenuous labor. The rings become soft, start to melt, break loose from the lining and fall into the kiln. As they roll toward the discharge end they generally break up into small pieces and leave the kiln in the same state as the regular discharge. Ring formation causes no decrease in recovery, as the zinc content of the rings is no higher than that of the normal discharge.

The Mansfeld procedure also offers a peculiar problem on account of the low melting point of the slag. Melting below 1,100 deg. C., the slag would become soft or even liquid in the kiln if no preventive measures were taken. At first, crushed lime was added as a stiffening agent, but this cut down the capacity considerably. Later, the discovery was made that the same result could be accomplished by increasing the coke in the charge to 35 per cent of the weight of the slag, with only a small sacrifice in capacity, and the addition of the lime as stiffening agent was therefore done away with.

Another difficulty encountered in this operation is attributable to the high sulphur content of the slag. Zinc sulphide is not reduced to metallic zinc unless the charge contains a sufficient amount of lime to combine with the sulphur. From the highly ferrous slag, however, some metallic iron is reduced, which reacts with the zinc sulphide, with the formation of metallic zinc and iron sulphide. This sulphide, together with sulphides of copper and lead mechanically occluded in the slag, segregates out as a low-grade copper matte, containing a large amount of dissolved metallic iron, more fusible than the charge and of higher specific gravity. The liquid matte stays at the bottom of the kiln, between the charge and the lining. If the operating conditions are such that large amounts of matte are formed, the charge will float on the liquid matte in an oscillating manner, instead of trundling in the kiln, which consequently rotates away from the charge. An excess of coke aids in overcoming this difficulty. Large accumulations of liquid matte are also prevented by constructing the lining of alternate sections of magnesite brick and fireclay brick in that part of the kiln where matte formation occurs. The softer fireclay brick wears down faster, leaving the magnesite brick protruding, thus breaking the larger pools of liquid matte up into smaller ones, which can cause no serious difficulty. The slag is worked at relatively low temperature, 1,120 to 1,140 deg. C., and the recovery is therefore lower than in most other Waelz plants. Frequent temperature measurements and gas analyses are taken to keep operating conditions uniform and to check an excess or a deficiency of air in the kiln.

The United States Steel Corporation has installed a kiln in its plant at Donora, Pa., for the treatment of muffle residue, current production, and residue from an old dump containing about one million tons. This residue, which already contains enough coal for reduction, is fed directly to a kiln 120 ft. long (36 m.), 10 ft. outside diameter (3 m.), with a capacity of 360 tons per 24 hours, which is expected to be increased to 400 tons. Natural gas is used for auxiliary heating. The plant requires only four men per shift for operation, the entire installation being mechanized as far as possible. Cottrell precipitation is used for collecting the oxide, which contains little lead and is reduced to metallic zinc by the regular retort process. The over-all recovery has averaged over 95 per cent over several months of continuous operation, and the plant has experienced few mechanical difficulties from ring formation or for any other reasons.

The New Jersey Zinc Company has installed a kiln at its Palmerton plant, 140 ft. long (42 m.), and with 10 ft. outside diameter (3 m.), which treats a varied feed, ore, residues, slime, flue dust, and other metallurgical products, using a cheap grade of coal for reduction, such as screenings from coal washing. This installation has been in operation for only a short time, but the results obtained are satisfactory. The oxide is collected in a baghouse and used for the production of lithopone.



Truck or Cableway?

A Comparison of Costs

Fred C. Carstarphen

FREQUENTLY, mine owners, managers, or engineers are called upon to estimate transportation costs. Often the problem has become one of determining the relative economies of hauling by trucks or transporting by cable tramways. Of course, a hard-and-fast rule cannot be developed that will cover all operations. For instance, the road may be so steep and crooked that the time of ascent and descent is out of line with average conditions. Also, in general, trucks receive and discharge their loads on platforms and after the receiving hopper is not included; that is to say, loading or receiving bins are not included in the prices given.

In high altitudes or in regions where roads are poor, weather conditions, such as rain, sleet, or snow, may block the use of trucks, though having little or no effect upon the operation of cable tramways. On the other hand, the amount of material to be handled may not be sufficient to warrant the expenditure required for a rope tramway.

The accompanying tables are believed to represent average conditions, and will be of service in making preliminary estimates. In both cases the cost of equipment ahead of the loading bin gate and after the receiving hopper is not included; that is to say, loading or receiving bins are not included in the prices given.

As in every other line of endeavor, management and the ability of the operating crew have a great influence upon such costs, so that the values presented may not meet with universal acceptance.

Highway contractors have noted that light trucks with drivers may be hired for as little as $1.50 per hour, whereas owners of heavier trucks ask $3 to $3.50 per hour. Reference to the table of truck costs will show that the owner of the light truck is content with a smaller profit than the big fellow. It is also interesting to note that the ton-mile cost of hauling the load half the distance traveled by the truck indicates that the 3½-ton rated size is the most economical size of truck for all-around heavy service. Trucking contracts are sometimes made at 15c. per ton-mile and are profitable as shown.

It is of further interest to note that, without allowances for road construction for trucks, or right-of-way charges for the cable tramway, it is only on short hauls (a mile for instance) and with a moderate burden (such as 100 near the ground, and if deliveries are to be made at elevations above the discharge height of the truck body, the cost of the elevating equipment must be added. This is not a limiting condition for cable tramways. In fact, they readily lend themselves to taking their load at a low point and delivering at a high one.

Cost of Operating Trucks per Day

Rated capacity, tons	1		1½		2		2½		3		3½		4		5	
Load in tons	1½		2½		3		3½		4½		5½		6		7½	
Cost	$800		$1,350		$1,650		$2,000		$2,250		$3,225		$4,000		$6,000	
Miles per gal. gas	15		10		7		6½		6		5½		5		4	
Miles per hour	25		22		20		18		15		15		12		10	
Miles per day	75	150	75	150	75	150	50	100	50	100	50	100	50	100	50	100
Annual interest, 6 per cent	$0.14	$0.14	$0.23	$0.23	$0.28	$0.28	$0.34	$0.34	$0.37	$0.37	$0.53	$0.53	$0.67	$0.67	$1.00	$1.00
Insurance	.20	.20	.25	.25	.26	.26	.27	.27	.28	.28	.33	.33	.40	.40	.60	.60
Driver's wages	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	6.00	6.00	9.00	9.00	9.00	9.00
Garage	.50	.50	.50	.50	.50	.50	.75	.75	.75	.75	.75	.75	1.00	1.00	1.00	1.00
License	.10	.10	.12	.12	.15	.15	.25	.25	.35	.35	.45	.45	.60	.60	.80	.80
Total fixed charges	$5.94	$5.94	$6.10	$6.10	$6.19	$6.19	$6.61	$6.61	$6.75	$6.75	$8.06	$8.06	$11.67	$11.67	$12.40	$12.40
Gasoline at 18c	.90	1.80	1.35	2.70	1.93	3.86	1.39	2.78	1.50	3.00	1.64	3.28	1.80	3.60	2.25	4.50
Oil and grease	.17	.35	.18	.36	.25	.50	.20	.40	.22	.44	.24	.48	.25	.50	.26	.52
Tires at 18,000 miles	.35	.70	.50	1.00	1.00	2.00	.95	1.90	1.05	2.10	1.27	2.54	1.50	3.00	1.55	3.10
Overhauling 30,000 miles	.55	1.10	.60	1.20	.62	1.24	.56	1.12	.63	1.26	.66	1.32	.68	1.36	.75	1.50
Painting	.06	.12	.07	.14	.10	.20	.11	.22	.15	.30	.15	.30	.15	.30	.16	.32
Depreciation 100,000 miles	.60	1.20	1.00	2.00	1.24	2.48	1.00	2.00	1.13	2.26	1.61	3.26	2.00	4.00	3.00	6.00
Miscellaneous	.55	1.10	.56	1.12	.75	1.50	.65	1.30	.80	1.60	.90	1.80	1.00	2.00	1.25	2.50
Total operating charges	$3.18	$6.37	$4.26	$8.52	$5.89	$11.78	$4.86	$9.72	$5.48	$10.96	$6.47	$12.94	$7.38	$14.76	$9.22	$18.44
Total all charges	9.12	12.31	10.36	14.62	12.08	17.97	11.47	16.33	12.23	17.71	14.53	21.00	19.05	26.43	21.62	30.84
Empty per mile	.122	.083	.138	.0976	.161	.120	.230	.163	.244	.177	.290	.210	.380	.268	.426	.308
Ton-mile load half dist	.160	.110	.123	.087	.107	.080	.122	.088	.117	.079	.111	.080	.127	.088	.115	.083

Cost of Operating Cable Tramways

Standing Track Cable, Continuous Type, Speed 500 Ft. per Min. Material Weight 100 Lb. per Cu.Ft.

Daily capacity, tons	100			250			400			600		
Length in miles	1	2.5	5	1	2.5	5	1	2.5	5	1	2.5	5
Cost	$20,700	$43,500	$81,500	$22,400	$47,150	$88,400	$28,500	$60,100	$112,900	$35,300	$74,000	$138,500
Annual interest 6 per cent	3.40	7.15	13.39	3.68	7.80	14.52	4.68	9.87	18.55	5.80	12.15	22.76
Depreciation 16-17 years	3.40	7.15	13.39	3.68	7.80	14.52	4.68	9.87	18.55	5.80	12.15	22.76
Labor	8.50	8.50	8.50	12.00	12.00	12.00	15.50	15.50	15.50	19.00	19.00	19.00
Supplies	.50	1.00	1.50	1.00	1.50	2.00	1.40	2.00	2.60	2.00	3.20	4.40
Repairs	2.80	3.00	3.20	3.60	4.00	4.40	5.20	5.60	6.00	5.60	6.00	6.50
Power and miscellaneous	2.00	2.25	2.50	3.00	3.30	3.60	4.00	4.35	4.70	5.00	5.40	5.80
Total	$20.60	$29.05	$42.48	$26.96	$36.40	$51.04	$35.46	$47.19	$65.90	$43.20	$57.90	$81.22
Cost per ton	.206	.291	.425	.104	.146	.204	.089	.118	.165	.072	.096	.135
Cost per ton-mile	.206	.116	.095	.104	.058	.041	.089	.047	.033	.072	.038	.027

Daily capacity, tons	750			1,000			1,500			2,000		
Length in miles	1	2.5	5	1	2.5	5	1	2.5	5	1	2.5	5
Cost	$42,800	$91,100	$171,600	$48,200	$98,300	$181,800	$57,800	$122,300	$230,000	$68,000	$143,000	$270,000
Annual interest 6 per cent	7.03	14.97	28.19	7.92	16.15	29.87	9.50	20.09	37.80	11.17	23.49	44.36
Depreciation 16-17 years	7.03	14.97	28.19	7.92	16.15	29.87	9.50	20.09	37.80	11.17	23.49	44.36
Labor	19.00	19.00	19.00	22.50	22.50	22.50	26.00	26.00	26.00	29.50	29.50	29.50
Supplies	2.50	4.25	6.00	3.00	5.00	7.00	4.00	6.25	9.50	5.00	8.00	11.00
Repairs	5.90	6.60	7.30	6.50	7.30	8.00	8.00	8.50	9.00	8.60	9.60	10.60
Power and miscellaneous	6.00	6.45	6.90	7.00	7.50	8.00	8.00	8.60	9.20	9.00	9.75	10.50
Total	47.46	66.24	95.58	54.84	74.60	105.24	65.00	89.53	129.30	74.44	103.83	150.32
Cost per ton	.063	.083	.127	.055	.075	.105	.043	.060	.086	.037	.052	.075
Cost per ton-mile	.063	.033	.025	.055	.030	.021	.043	.024	.017	.037	.021	.015

tons per day) that trucks offer serious competition with cable tramways. This is because the tramway terminals are a fixed charge irrespective of the length of the line and greatly exceed the cost of a light-weight truck.

With greater tonnages and distances, the tramway is in a class by itself in offering economical transportation costs. This is true, in spite of the great advantage that comes to the truck in having a roadway provided at public expense, an advantage that becomes obvious when immediate transportation must be had.

I hope that these data will fill a long-felt want for a guide in comparing costs of transportation by the two systems.

Welding On Leyner Shank Lugs

A FEW YEARS AGO the welding on of Leyner shank lugs undoubtedly would have been considered uneconomical, as well as injurious to the drill steel. Today, however, improved welding apparatus, with which the heat can be controlled at the will of the operator, and the variety of welding rods composed of materials to meet the requirement of almost any welding problem, make the welding on of shank lugs not only practical but also economical. The main argument against the practice is the possibility of decarbonizing or burning the drill steel by excessive heating. This, however, can be avoided by using a small tip or neutral flame and by slowly building up the material to a carbon content equal to that of the drill steel. Selection of a welding rod that has been proved to be suitable by experiment, and able handling of the torch, are the two factors governing the successful application of the entire process.

What can be said about forged shanks? Is not the forging of a shank, which requires several heats, a severe test for the steel? And does not the excess strain caused by the forging weaken the shank at the lugs? Practice has shown that very few of a batch of forged shanks can be termed perfect. The deformed hole (see Fig. 2) at the lug section of the shank is common and the main cause for clogged drills. Consequently, a larger number of drills must be supplied to the miner on account of this occurrence, especially when drilling in soft ground. Furthermore, shanks invariably break at the points indicated in Fig. 2. Two fine cracks extending from the deformed hole almost to the edge of the drill, as shown in Fig. 3, can be detected when examining the cross-section under the microscope—a logical appearance in view of the excess strains in the material resulting from severe forging.

To weld the lugs by the acetylene process, instead of forging them, not only is economical, but also produces a stronger and better shank, with an uninjured hole. The elimination of a helper on the drill sharpener, and the time saved—welded lugs require only a rectifying in the shanking device of the sharpener—will be counterbalanced by the cost of oxygen, welding material, and an operator. A saving, however, is effected on sharpener parts, such as the shanking device and punching pins, because the wear on these parts is not severe and frequent replacement is unnecessary.

Welding on of lugs has been successfully developed by E. Morton, master mechanic at the Utah-Apex mine, at Bingham, Utah. A few interesting facts follow:

The only additional equipment required for the process is a device to facilitate a uniform welding of the lugs. Fig. 1 illustrates such a device. This consists of a ¾x4-in. flat iron base which is provided with a number of ⅜-in. holes enabling the operator to adjust the two supports to the length of the drill by means of ⅜-in. guide pins in the supports. Both supports are machined, have a 45-deg. tapered groove to accommodate the drill; support No. 1 is designed so as to act as a guide. A rectangular slot is provided to indicate to the operator the exact location and height of the lugs. About 70 drills can be welded per eight-hour shift with this device.

After considerable experimenting with Oxweld No. 1 and No. 2 and chrome-nickel No. 3 welding rods, Oxweld No. 2 was found to give the best results. Oxweld No. 1 produced lugs too soft and chrome-nickel No. 3 lugs that were too hard and brittle. All welded shanks are annealed before being rectified in the shanking device of the sharpener. This procedure requires but a few blows, and no deformation of the hole near the lug section of the shank has resulted. The shanks are then reheated to 1,650 deg. F. and cooled in transformer oil to give them an even temper.

To date more than 3,000 drills with welded-on lugs are in use at the Utah-Apex mine, and about 450 drills are being sharpened and reconditioned each day. Among this number of drills, only two or three are broken at the shank, compared with six to ten among an equal number with forged shanks—a reduction of more than 50 per cent. An increase of production has also been experienced; whereas formerly 50 shanks were forged, ground, and tempered per eight-hour shift, 80 drills are at present made in the same period.

The breaking points of the welded shanks, shown in Fig. 4, are in an unusual position. Apparently, the lug section of the shank is perfectly sound, the breaks occurring either above or below the lugs. The exact cause of this occurrence has not so far been definitely determined.

Equipment for welding on lugs

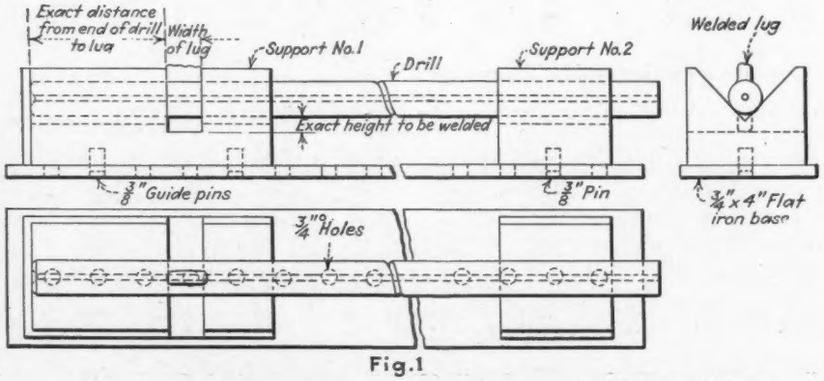


Fig.1

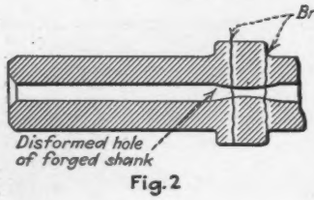


Fig.2

Fig.3

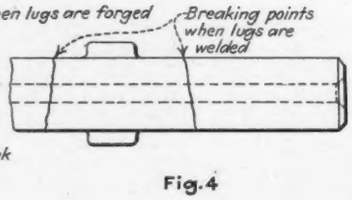


Fig.4

Processing Rock Salt for the Market

H. D. Keiser
Assistant Editor

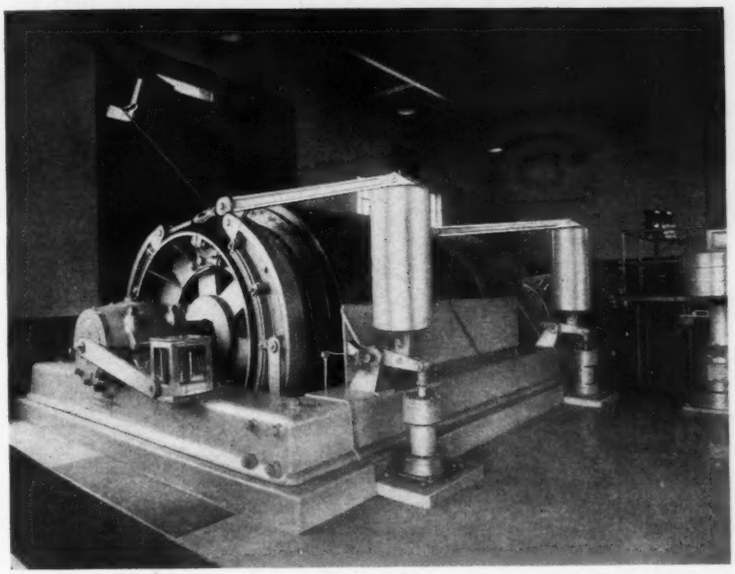


Fig. 1—The hoist installation at No. 2 shaft; the walls and floor of the hoist house, as well as the hoist itself, are painted a light gray

CREDIT for pioneering in the adaptation of mechanized mining and processing operations in the rock-salt industry may justly be granted the Detroit Rock Salt Company. Economic circumstances, which were enumerated in a preceding article entitled "Mining Rock Salt in Michigan," were undoubtedly important contributing factors in influencing the company to utilize labor-saving equipment wherever possible. However, a particularly difficult economic situation that would naturally make economy in labor advisable could not be entirely responsible for the unusual efficiency readily apparent in the operations at the property—this must be attributed solely to a capable and foresighted management.

References to this efficiency that were made in the aforesaid article on underground methods are equally applicable in regard to surface operations. For instance, the hoist house at No. 2 shaft is exceptionally clean, besides being well ventilated and lighted. The hoist and motor, in addition to the floor and walls, are painted a light gray and are kept spotless, as is evident from Figs. 1 and 2. A description of the surface plant and operations follows.

The cylindrical winding surface of the Ottumwa hoist is 16 ft. long and 11 ft. in diameter; the smaller portion of the conical section of the drum is 8 ft. in diameter. A 1½-in. hoisting cable is used. Power for the hoist is supplied through Sykes herringbone reduction gears by a General Electric Type-MT-20 induction motor. This motor, which is shown in Fig. 2, is rated at 600 hp. and at 350 r.p.m., under full-load conditions; a 4,600-volt 60-cycle alternating current is employed.

The 6-ton skips used at No. 2 shaft, one of which is shown in Fig. 3, are hoisted to the top of the headframe, where they are automatically dumped into the skip bin. This bin is built of steel and concrete, and is an integral part of the headframe structure. Preparation of the salt for the market consists of subjecting the salt, as mined, to a series of crushing, picking, and screening operations. These are performed in two buildings known as the "new breaker" and "old breaker" buildings, which are connected by a 200-ft. conveyor gallery. Primary and secondary crushing, as well as initial screening and picking operations, are housed in the new breaker building. This building, which is shown in Figs. 4 and 5, was designed by the Allen & Garcia Company. Operations in the old breaker building comprise recrush-

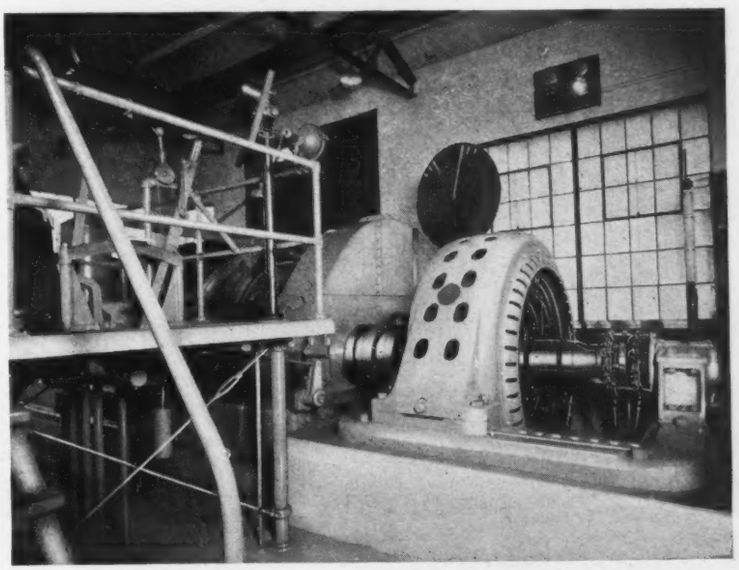


Fig. 2—The 600-hp. induction motor that operates the hoist at No. 2 shaft

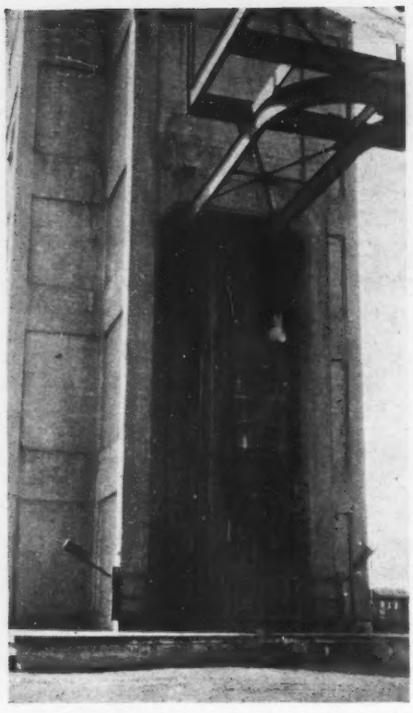


Fig. 3—One of the 6-ton skips

ing, final picking and screening, and shipping. A surface crew of 45 workers is employed.

Consumers of the various grades of salt produced by the company include meat packers; ice-cream manufacturers; chemical and water-softening plants; steam and electric railways, for melting snow and ice; railroads, in connection with the icing of refrigerator cars; and manufacturers of tile and clay products, for glazing purposes.

As indicated in the flow sheet in Fig. 6, the salt, which varies in size from 18 in. to fines, passes from the skip bin in the new breaker building, onto a 4x8-ft. Weller rotary grizzly, spaced at 6 in. The oversize, as shown in Fig. 7, falls onto a 48-in. belt conveyor equipped with a Dings 24-in. magnetic head pulley. This pulley removes (1) the loose pieces of iron detonating wire that are mixed with the salt as a result of electric blasting; and (2) any larger pieces of tramp iron that may be present. The conveyor discharges into a Kennedy-Van Saun jaw crusher, where a reduction to 6 in. is effected. A 30-in. x 24-ft. picking belt, which receives the products of the jaw crusher, discharges the salt into a Pennsylvania corrugated single-roll crusher. The undersize from the Weller grizzly is fed in equal portions to two ¾-in.-mesh Hum-mer screens, the oversize of each of which passes onto a 30-in. x 24-ft. picking belt. On leaving the picking belt, the salt joins that from the Pennsylvania crusher and enters an 8x24-ft. Bradford rotary breaker, equipped with

Fig. 5—New breaker building, looking north

Fig. 4—New breaker building, looking west

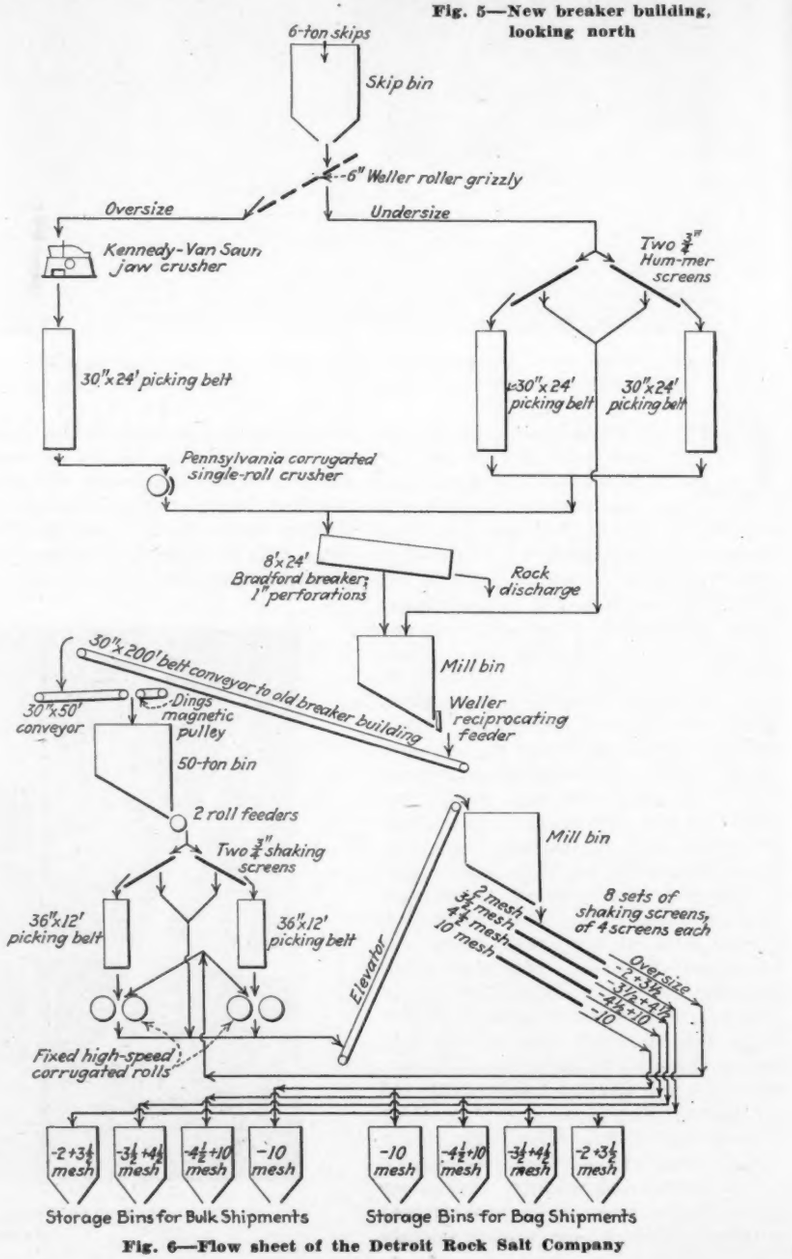


Fig. 6—Flow sheet of the Detroit Rock Salt Company

Fig. 7—Rotary grizzly installation

1-in. perforated plates. The minus 1-in. product of the breaker joins the undersize from the Hum-mer screens and passes into a mill bin. From the bin, the salt is discharged by a Weller reciprocating feeder onto a 30-in. x 200-ft. belt conveyor, which is shown in Figs. 8 and 9. This conveyor discharges onto a 30-in. x 50-ft. cross conveyor, which, in turn, discharges into a 50-ton bin in the old breaker building.

A Dings magnetic pulley, opposite the discharge end of the cross conveyor, removes small pieces of iron that may have been imbedded in the salt prior to crushing, as well as short lengths of detonating wire. The salt is fed from the bin by two roll feeders onto two ¾-in. locally made shaking screens, the oversize from each of which passes to a 36-in. x 12-ft. picking belt. Each picking belt discharges into a set of 12x24-in. corrugated high-speed rolls, the roll product joining the undersize of the shaking screens and passing to an elevator that discharges into a bin. From this bin, the salt is fed to eight sets of shaking screens, each set consisting of four screens.

The top screen of each set is a 2-mesh screen. Under that is a 3½-mesh screen, next a 4½-mesh screen, and then a 10-mesh screen. Oversize of the 2-mesh screens is returned to the two sets of corrugated rolls. The four products of the screens—namely, minus 2 plus 3½ mesh, minus 3½ plus 4½ mesh, minus 4½ plus 10 mesh, and minus 10 mesh—are stored in two sets of bins, one for bulk shipments and the other for bag shipments.

Both bulk and bag shipments are made in box cars. In bulk loading, the salt is drawn from the storage bins into the hopper of an automatic car-loader of the conveyor type that can be moved from one car to another along an overhead support as loading proceeds. Salt for bag shipment is drawn from the bag-storage bins into the hopper of a weighing scale. The bags are filled with the desired quantity and then sewed. Belt conveyors transport the bags to the shipping platform, where they are loaded into cars.

The treatment practice employed by the company in preparing the crude salt for the market includes the application of much equipment of special design that is indicative of the efficiency and progressiveness of the management. In exemplification of this may be cited the unusual construction of the conveyor idlers. Corrosion is an arch enemy at any salt plant. Although its usual effect is to cause an early scrapping of equipment, corrosion may interfere with operations and affect the quality of mill products. Such, at least, was the situation at the plant of the Detroit Rock Salt Company several years ago, when the customary plain steel idlers were in use on the various conveyors. Serious corrosion and incrustation occurred on the contact surfaces. Incrustation not only interfered with conveyor operation and increased the wear on the belts, but also, when it flaked off, contaminated the salt that was transported on the belts. These difficulties were avoided by replacing

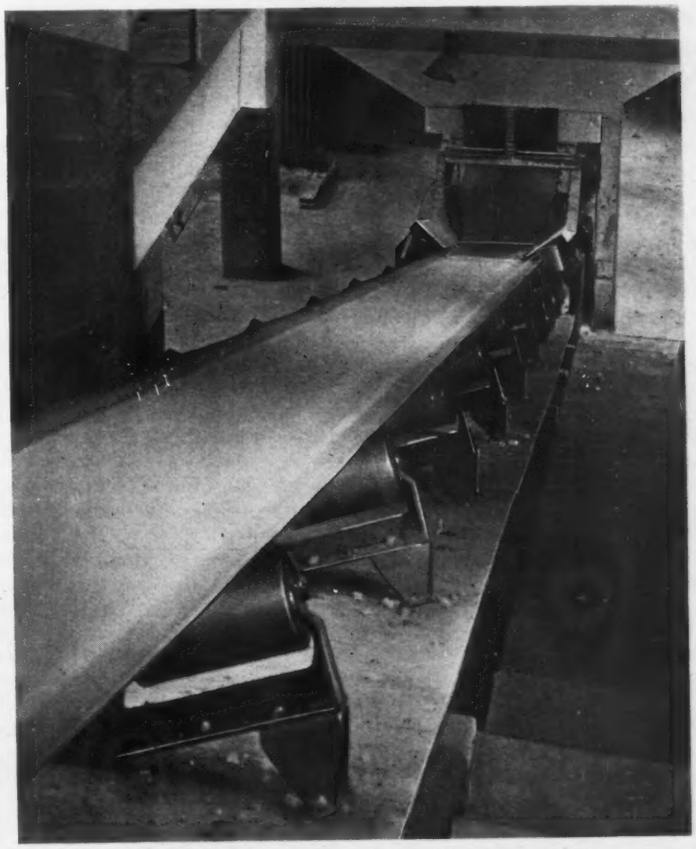


Fig. 8—Reciprocating feeder discharging onto the conveyor connecting the old and new breaker buildings

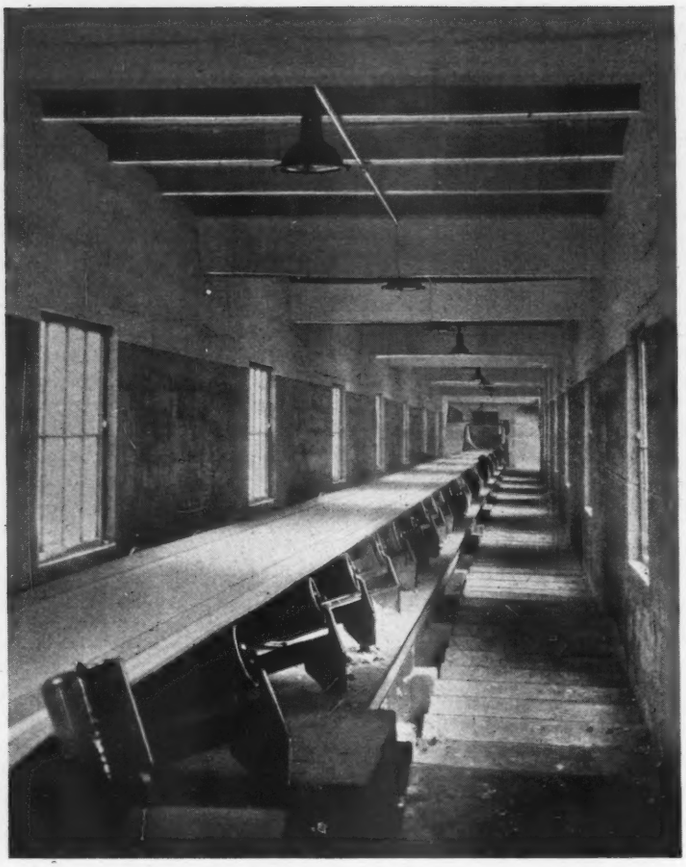


Fig. 9—Looking down the conveyor gallery; the "granitized" or porcelain-enameled idlers used in combating corrosion are readily noticeable

the plain steel idlers with Link-Belt "granitized" idlers of the anti-friction type. The granitized or porcelain-enameled surfaces of the idlers removed the possibility of corrosion and hence of incrustation. The clean condition of these idlers is readily apparent in Figs. 8 and 9, which show the major portion of the conveyor gallery.

Much of the equipment in both the new and the old breaker buildings is driven by individual motors. The electric power is obtained from the Detroit Edison Company and is brought onto the property at 4,600 volts. Power for underground use is converted to lower voltages at the bottom of No. 2 shaft; that for surface use is reduced in the transformer room, which adjoins the hoist room in No. 2 hoist house.

In addition to the two breaker buildings and structures at the two shafts, surface plant includes a 24x60-ft. change house, 30x60-ft. stock-room building, 40x120-ft. shop building, and an office building. Cleanliness, similar to that referred to in describing the interior of No. 2 hoist house, prevails in all these buildings.

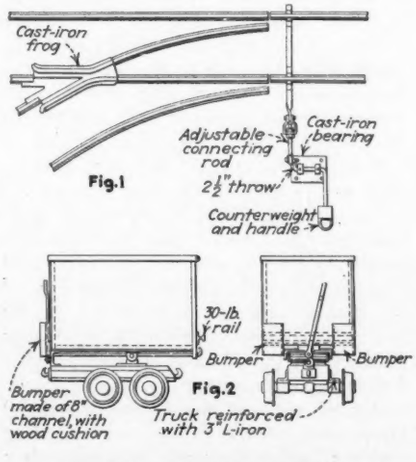
Before the visit to the property was concluded, it was apparent that the unusual cleanliness of which mention has here been made was not merely the result of an extraordinary amount of labor expended on cleaning-up operations, but rather represented cooperative effort on the part of the personnel not to permit the property to become untidy in any respect. In discussing this subject with the late G. W. Hain, formerly general manager, he said: "Keeping the property cleaned up has paid from the start. In fact, the sale of the scrap collected when we started to clean up the property some years ago paid all the costs involved in collecting the scrap and in placing the grounds in the condition in which you now see them." The guess is hazarded that in this forceful attitude against untidiness, with which the entire personnel of the company seems to be imbued, may be found the fundamental reason for a large portion of the company's efficient and successful management.

Permission to visit the property of the Detroit Rock Salt Company and to prepare this article, as well as a preceding one, "Mining Rock Salt in Michigan," was courteously granted by Mortimer B. Fuller, president of the company. I desire especially, in conclusion, to record my sincere appreciation of the courtesy of Mr. Hain in supplying the information presented in these articles and to mention gratefully his geniality as a host, the usual from of acknowledgment being impossible, owing to his recent and premature passing.

Alterations on Cars and Switches at Honerine

AT THE Honerine mine of the Combined Metals Reduction Company, at Bauer, Utah, the ore from the mine is hauled to the mill over a 24-in.-gage track in standard revolving dump cars of 30-cu.ft. capacity. These cars are drawn by small storage-battery locomotives, and are transferred at various points by stub switches. For some time an increase of repair and maintenance costs was experienced, and a careful inspection revealed that the rapid wear and loosening of the home-made steel switch frogs, and an inefficient switch throw mechanism, caused an increased number of broken wheels and wrecks.

Minor alterations were made, with satisfactory results, in an effort to remedy the aforesaid difficulties. All-steel frogs were replaced with cast-iron frogs, and, instead of the old throw mechanism, one of more sturdy construction and of an adjustable nature, as shown in Fig. 1, was used. The throw-bar, with its 2½-in. crank, is made in one piece, of 1-in. round steel. After the crank has been formed, the bar is placed into the cast-iron bearing, and the straight end heated and bent into the desired position. The connecting rod is adjustable, insuring a constant correct position of the switch points. The car bumpers consist of two 8-in. channel irons, 12 in. long, fitted with wooden blocks to act as a cushion, and a short length of 30-lb. rail. These are bolted onto the lever end and door, respectively, of each car, as illustrated in Fig. 2; this makes a deformation of the car body and door by excessive bumping practically impossible. Furthermore, by reinforcing the truck frame with 3-in. angle irons, and replacing the ⅝-in. bolts with others ¾ in. in diameter and pressing them into carefully reamed wheel-bearing and angle-iron holes, a loosening of the wheel bearing has been overcome. In addition to an increased tonnage of ore hauled, repair costs have been decreased more than 50 per cent.



Improved stub switch and dump car

Non-Ferrous Metal Industry of Soviet Russia

V. Karmashov

Technical Bureau, Non-Ferrous Metal Industry of U.S.S.R.

SWIFT PROGRESS is being made in the industrial development of the U.S.S.R., particularly in the non-ferrous metal industry, practically a new industry in the Soviet Union if gold and platinum are excepted.

Pre-War production of copper, the basic metal of the non-ferrous metal industry, was almost nil. Other metals were not exploited. All the non-ferrous metals required in the country were imported. The production of smelted copper, prior to the revolution and the subsequent expansion of the industry, was as follows: 1900, 8,265 tons; 1908, 14,000; 1913, 29,000; 1917, 16,000; 1922, 1,758; 1926, 12,439; 1929, 37,000 tons. In the figure for 1929 is included 7,000 tons accruing from waste and scrap. The re-treatment of copper waste and scrap to procure pure metals began about 1925. Before the War, attempts only had been made, and the output amounted to about 3,000 tons annually.

Copper smelting increased about 70 per cent between 1900 and 1909. For five years, from 1908 to 1913, the output increased about 105 per cent. The year 1929 was a record one. It was also the first year of the revised program of the Five-Year Plan, which greatly increased the output indicated in the original plan.

At present industry in the U.S.S.R. requires a far larger supply of non-ferrous metals than in pre-War days. The output of the non-ferrous metal industry does not yet meet the requirements of the domestic market. Imports are still necessary. The comparison of industries using non-ferrous metals with pre-War conditions will illustrate to some extent the present situation in regard to the non-ferrous metal industry. Electrification and the electro-technical industry have been almost trebled since the War. The total capacity of all electrical power stations before the War was 950,000 kw. In 1929 the total capacity was 2,500,000 kw., and in 1932, the last year of the Five-Year Plan, the capacity, excepting small local stations, will be 6,500,000 kw. The erection of power stations has proceeded apace during the past decade. In view of the fact that the government has to spend a considerable amount of currency for the import of non-ferrous metals necessary to make up the deficit in the country, a determined effort is being made to develop the existing non-ferrous metal plants and mines to their greater capacity, and to construct new ones.

A special drilling trust, the Burtzwetmet, has been organized to determine the extent of previously discovered deposits of non-ferrous metals. Two years ago a special institute, the Giprotzwetmet, in which 500 persons are engaged—150 engineers, besides technicians and draftsmen—was also established to design new and to reconstruct old mines and plants in the non-ferrous metal industry. Gintzwetmet, a State Scientific Research Institute, was organized twelve months ago. This institute specializes in scientific research and in the improvement of technological and metallurgical processes connected with mining, smelting, and refining of non-ferrous metals. These organizations have already achieved considerable results. Deposits of non-ferrous metals have been prospected in the Urals, Turkestan, and in Southern and Eastern Siberia. Based on the deposits surveyed and newest technical processes, the new plants mentioned in the accompanying tables are being designed and old plants reconstructed.

Of the plants named the only old plant is the Alagir distillation zinc plant. All the others are of new construction. The first unit of the Ridder plant is complete and has been in operation for two years. A second unit is being constructed. The Konstantinovka plant is being completed and will begin operations in a few months. In two or three months the designs will be completed for the Cheliabinsk and Kemerovo plants, and building will begin this year.

Of the foregoing list, Alagir, the only

Zinc

	Present Annual Capacity Concentrate in Tons (Metric)	Planned Annual Capacity Pure Metal in Tons (Metric)
1. Ridder electrolytic zinc plant (Altai). Only concentrate now being produced	16,000	25,000
2. Alagir electrolytic and distillation zinc plant (North Caucasus)	4,000	10,000
3. Cheliabinsk electrolytic zinc plant, Central Urals	.....	20,000
4. Kemerovo electrolytic zinc plant, Western Siberia, Kuzbas region	.....	60,000
5. Konstantinovka distillation zinc plant; near Kharkov	.....	20,000
Totals	20,000	135,000

Lead

	Present Annual Pure Metal Capacity in Tons (Metric)	Planned Annual Pure Metal Capacity in Tons (Metric)
1. Ridder lead plant, Altai Mountains	5,000	18,000
2. Alagir lead plant, North Caucasus	1,000	5,000
3. Chimkent lead plant, Turkestan, 45 per cent lead in ore, without other metals	New	50,000
4. Nerchzinc lead plant, East Siberia	New	20,000
5. Moscow lead smelting and refining plant, for secondary lead	New	50,000
Totals	6,000	143,000

Copper

	Present Annual Pure Metal Capacity in Tons (Metric)	Planned Annual Pure Metal Capacity in Tons (Metric)
1. Reconstruction of Karabash Combine, Ural	15,000	20,000
2. Reconstruction of Kalatinsky Combine, Ural	12,000	15,000
3. Krasnoural copper smelting plant, formerly Bogomolstroy, Ural New plant being completed, opening September, 1930		25,000
4. Reconstruction of Bashgortrest plants, South Ural (Silver mines)	3,000	10,000
5. Degtiarsky plant, concession enterprise	3,000	25,000
6. Zakavkazky copper smelting combine, Armenia (Alaverdy and Sangesur mines)	3,000	15,000
7. Kazmedstroy, East Turkestan, Kounrad, Semis-Bugu, Kaktas-Djar, Kaktas-Djartas, Spasski mines	New	60,000
8. Korsak-Pai plant. New plant completed and opened 1½ years ago	5,000	15,000
9. Moscow copper refining plant for secondary metals. New plant completed in 1929	5,000	15,000
Total	46,000	200,000

old plant, is now being expanded. The first unit of Ridder is finished and has been operating for the past two years. A second unit is under construction. Designs of other plants will be completed in a few months, and construction started this year.

The proposed Kazmedstroi plant will begin operations, with ore from local mines, early in 1932. To provide adequate transport facilities for future operations of the plant, a railroad, 800 kilometers long, is being constructed.

Copper Rolling and Manufacturing Plants

	Present Annual Pure Metal Capacity in Tons (Metric)	Planned Annual Pure Metal Capacity in Tons (Metric)
1. New Ural copper rolling plant (Cheliabinsk)	.....	150,000
2. Electrolytic copper refining plant (Cheliabinsk)	.....	100,000
3. Reconstruction of plant Krasny Vyborjetz (Leningrad). Part of this plant has an electrolytic refining section for secondary metals with an output of	8,000	30,000 to 50,000
4. Reconstruction of Kolchugin plant (near Moscow)		45,000 to 80,000
5. Reconstruction of Podolsk plant for manufacturing alloys from white metals (near Moscow)		2,000 to 4,000
6. Duralumin plant (capacity undetermined)	.....	.....

Kolchugin and Krasny Vyborjetz are old plants with a pre-War production of about 60,000 tons. The other plants are under construction. The Duralumin plant will be completed this year. Present and prospective productions of nickel, quicksilver, and aluminum follow:

Nickel

	Present Annual Pure Metal Capacity in Tons (Metric)	Planned Annual Pure Metal Capacity in Tons (Metric)
Ural nickel plant in Upper Ufaleia (Ural)	.....	2,500

Quicksilver

Nikitovsky quicksilver plant (Ukraine)	100	500

Aluminum

1. Leningrad aluminum plant (Construction completed)	.....	5,000
2. Dnepropetrovsk aluminum plant (Under construction)	.....	15,000
Total		20,000

Before the War the only non-ferrous metals produced were gold, platinum, silver, and copper, and a few tons of lead. At present copper, lead, zinc, quicksilver, tungsten, molybdenum, aluminum, gold, platinum, and silver are being produced. At the end of the Five-Year Plan period, magnesium, tin, nickel, and antimony will be produced. The total tonnage of non-ferrous metals by the end of the aforesaid period, 1932, is estimated to be as follows: Copper, 185,000, with 15,000 tons from secondary metals; zinc, 135,000; lead, 128,000; aluminum, 20,000; nickel, 2,500; quicksilver, 600; magnesium, 1,000; antimony, 1,000; tin, 1,000; with molybdenum, tungsten, and cadmium in amounts at present indeterminable.

Nevertheless, in spite of the fact that at the end of the Five-Year Plan period the output of copper will be increased almost six times and that new metals, such as lead and zinc, will be produced in hundreds of thousands of tons, the U.S.S.R. will still be in need of imported non-ferrous metals. The demand for these is great, as a result of the program of construction in the Soviet Union.

When the program for the Five-Year Plan was being drawn up, 20 per cent of the copper, lead, zinc, and gold was expected to be produced by the concession enterprise, Lena Goldfields, but that contract has been canceled, for alleged breach, and a claim is pending in the London courts, against the company. Therefore, the whole work of construction will be conducted with the help of Russia's own resources, with the exception of lead and zinc mines and a dressing plant in Tetukhe, 250 kilometers north of Vladivostok on the shores of the Japanese Sea, which is being worked by an efficient British concession. Lead, from the plant in Tetukhe, is mostly exported. Zinc concentrates are shipped by sea to Konstantinovka, where a distillation plant, with an annual capacity of 20,000 tons, will soon be placed in operation.

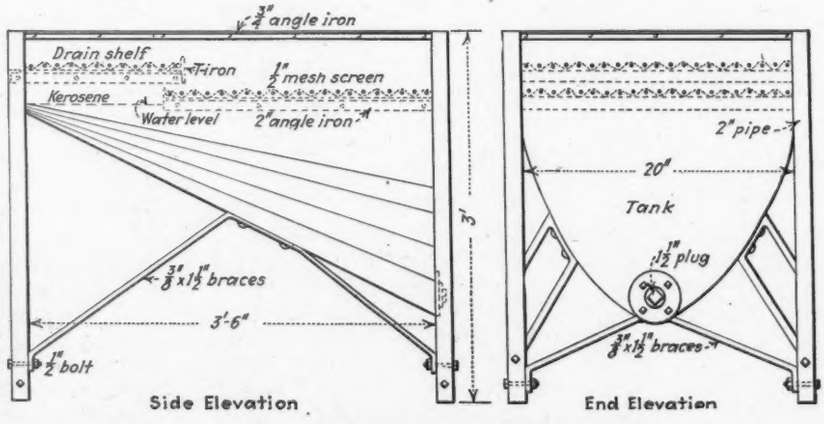
The Soviet Union finds it difficult to supply the required number of technicians and, therefore, it has sought help abroad, chiefly in the United States of America. Consolidated non-ferrous metal industries in U.S.S.R. have already concluded contracts for technical aid in designing and starting operations of new plants with Archer E. Wheeler and Southwestern Engineering Corporation. In addition, the representative in New York has engaged many American engineers. As a result of these efforts there are now working in the U.S.S.R., in the plants and mines of the non-ferrous metal industries, nearly 80 technicians from the United States, 65 of whom are engineers, and 15 of whom are classed as mechanics.

Cleaning Tank for Machine Parts

MANY machine parts have to be cleaned with kerosene or gasoline, writes Charles Labbe, and some must remain in the bath for quite a while to dissolve accumulated dirt or grease. Pans or tin cans are frequently used, but a washing tank is not expensive and soon pays for itself in kerosene saved, greater ease and facility of operation, and cleaner results.

A suitable design is shown in the accompanying sketch. The tank is made of No. 20 iron, with a sloping bottom provided with a drain plug. On each side, 6 in. from the top, a piece of angle iron to hold a screen is riveted or welded inside the tank. The screen is fitted loosely in the tank and rests on the angle iron. At one end and above the level of the liquid is the drain shelf made of either screen or sheet iron. The tank legs are made of 1½- or 2-in. pipe, bolted or welded to the tank and reinforced with braces.

The tank is filled with water to within ¼ in. of the screen, and kerosene is poured in to a depth of 1 in. or more. Mud or black deposit does not contaminate the kerosene, because both settle in the water. When necessary most of the water and sludge can be drawn out through the bottom plug. Clear water is then added to bring back the level of the kerosene above the screen.



General details of cleaning tank

ORE MIXTURE CHART

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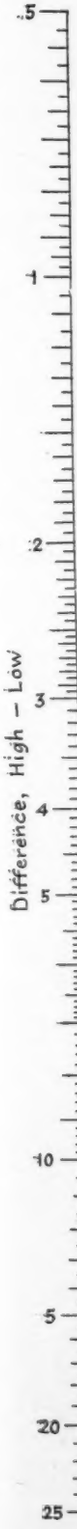
Sydney C. Mifflen



THIS chart is for use in determining the proportions of two similar ores to obtain a mixture having a required percentage of any given constituent.

EXAMPLE: Ore from two mines runs 8.3 and 15.8 per cent metal. In what proportions must it be mixed so that the metal content is 11.5 per cent?

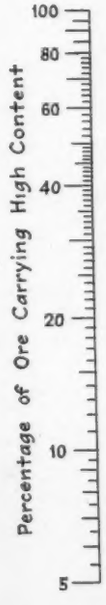
PROCEDURE: The metal ranges from 8.3 to 15.8, a difference of 7.5 per cent between the high and the low. The desired mixture is to carry 11.5 per cent, an increase of 3.2 per cent over the low-metal ore. Find 7.5 on the *Difference, High-Low* scale, and 3.2 on the *Difference, Medium-Low* scale; join to intersect the middle scale at a point reading 42.7, which is the percentage of the high-metal ore required in the mixture to afford a metal content of 11.5 per cent in the whole. Note that the middle scale always gives the percentage required of the ore high in the constituent in question.

The chart may also be used to find the percentage of any constituent in a mixture of any number of ores.

EXAMPLE: A day's output consists of:

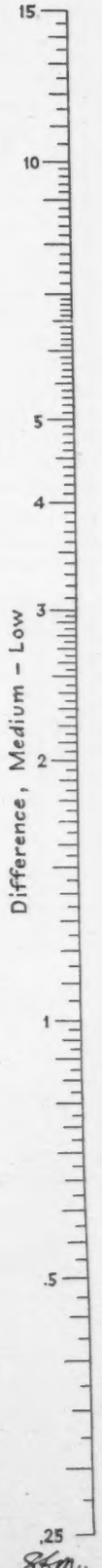
925 tons from No. 1 Mine, 60.6 per cent iron
1,575 tons from No. 2 Mine, 52.3 per cent iron
3,750 tons from No. 3 Mine, 58.3 per cent iron

What is the iron content of the whole?



PROCEDURE: Consider first a mixture of ores from mines 1 and 2, of which No. 1 (the high) will form 37 per cent. The ores have a range of from 60.6 to 52.3 per cent, or 8.3 per cent. Find 8.3 on the *Difference, High-Low* scale, and 37 on the middle scale, which shows the percentage in the mixture of the ore carrying the high content; join and produce to intersect the third scale at a point reading 3.1, the amount by which the iron in the mixture exceeds that in the low-metal ore. Therefore, the iron content of the mixture equals 3.1+52.3, or 55.4 per cent.

We now have 2,500 tons carrying 55.4 per cent to mix with 3,750 tons having a content of 58.3 per cent. Repeating the above operation shows that the mixture as a whole runs 57.1 per cent iron.



Mining and Milling

BARITE

Operations of the National Pigments Company in Mariposa County, Calif.—Product Is Used Largely in Oil-Well Drilling

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Associate Editor,
San Francisco

Fig. 1—Barite-cleaning plant of National Pigments Company. In background, mine openings on barite deposits.

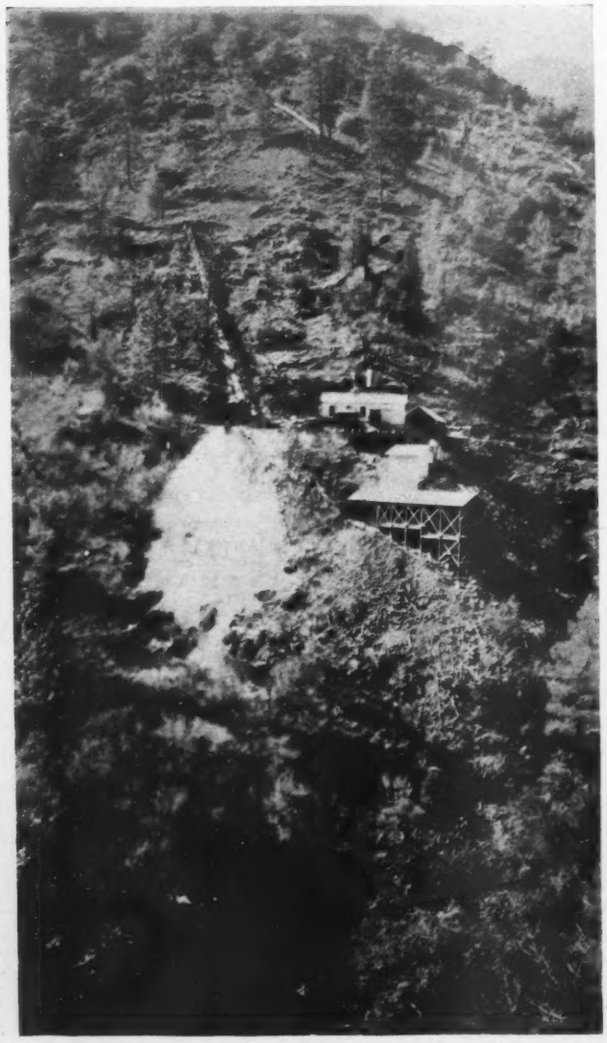
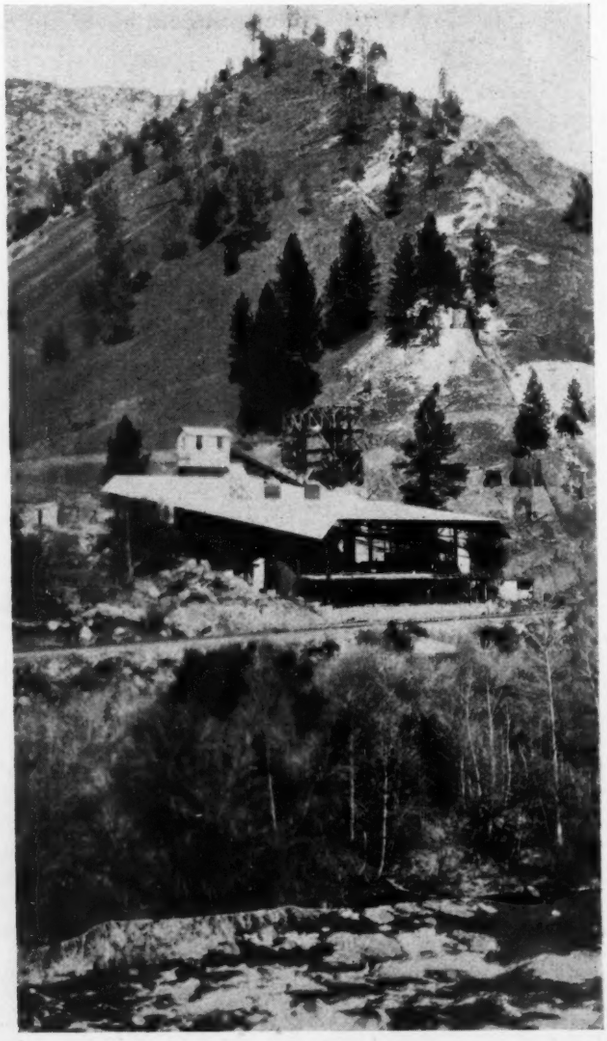


Fig. 2—Loading terminal, crusher, and quarry plant of National Pigments Company



A SUCCESSFUL barytes-mining enterprise operates about a mile west of El Portal, on the Merced River in Mariposa County, Calif. Barite was first discovered and mined in this region in the 'eighties, on the north side of the river. Later, El Portal Mining Company and Western Rock Products Company exploited the deposit. Subsequently the Yosemite Barium Company acquired the property, and in 1927 opened up a series of lenses south of the river. The barite was marketed in crude form, and about 75 tons per day was shipped, being hauled by motor truck to El Portal. Later the National Pigments Company acquired the property.

The barite deposits, in the form of irregular lenses in schists and slates, appear to be part of the Calaveras formation, a wide zone of metamorphics of Carboniferous age, intruded by granites and granodiorites. The area is near the eastern granite belt that begins near El Portal and extends to the upper high country beyond Yosemite Valley. Elevation of the deposit near the river is 2,000 ft., but to the south the elevations rapidly increase. About five miles south of the river, at an elevation of 5,000 ft., according to reports of the State Mineralogist, more barite has been discovered and some work done.

The property of the National Pigments Company is accessible to railroad transportation, as the Yosemite Valley Railroad extends on the north side of the Merced River, and a spur has been built to the new treatment plant, which has been in operation for about two months. A barite lens about 150 ft. maximum width and about 1,000 ft. in length, south of the river and several hundred feet above it, is being mined by quarry and glory-hole methods. The crushed product is transported to the plant on the north side of the river by a Leschen wire-rope tram 3,400 ft. in length. Raw material is crushed to 1⅛ in. maximum size. A motor is used on the tramway for starting and also for controlling speed. A 610-cu.ft. Ingersoll-Rand compressor supplies the quarry and a Sullivan drill sharpener is used for sharpening steel. A 35-hp. single-drum hoist serves an incline up which men and supplies are transported from the highway to the quarry.

Cleaning and dressing are performed in a plant, recently constructed, north of the river. This plant is of steel-frame construction, with a galvanized corrugated steel roof, and open on all four sides. The wire-rope tramway discharges into a receiving bin, from which a belt conveyor extends to a mill storage bin of 200 tons' capacity. The barite is fed to two Woodbury jigs, which remove most of the quartz and rock. Heavy mineral is discharged into a bucket elevator and raised to a second bin, from which it is fed to an 8 ft. x 36 in. Hardinge mill, operated in closed circuit with a drag classifier. The overflow is pumped to a nest of four cone classifiers, the underflow returning to the Hardinge mill and the overflow passing over a screen, to remove chips; and thence to a Dorr thickener. A Dorrco pump removes the thickened pulp and discharges into a mixing tank and thence to a splash box beneath a film drier. A revolving splasher throws the pulp against the drum of the drier, 5 ft. in diameter and 14 ft. long, as it slowly revolves. The drum, of welded construction with trunnion inlet and outlet, is heated by live steam supplied by an oil-fired boiler, 150 hp., Scotch marine type. A wooden hood and wooden stack remove the vapor. About 9 gal. of fuel oil is required to dry one ton of barite.

The pulp, which adheres to the drum as a thin film, is rapidly dried as the drum revolves. Scrapers remove the deposit of fine dry barite and carry it by screw conveyors and elevator to the Rotex screens above the finished bin into which the product is received. From the bin the barite is discharged by a revolving rake to a center discharge, and delivered by screw conveyors and elevators to four sacking machines, designed at the plant. A small-diameter screw conveyor feeds the material to the funnel about which the sack is attached. The sack is supported on a scale. When the weight of barite within the sack reaches 100 lb., the feed screw is automatically stopped. The final product, 99.95 per cent through 325 mesh, contains about 94 per cent barite. It is used principally for oil-well work, as described in *Engineering and Mining Journal* of March 8, p. 224.

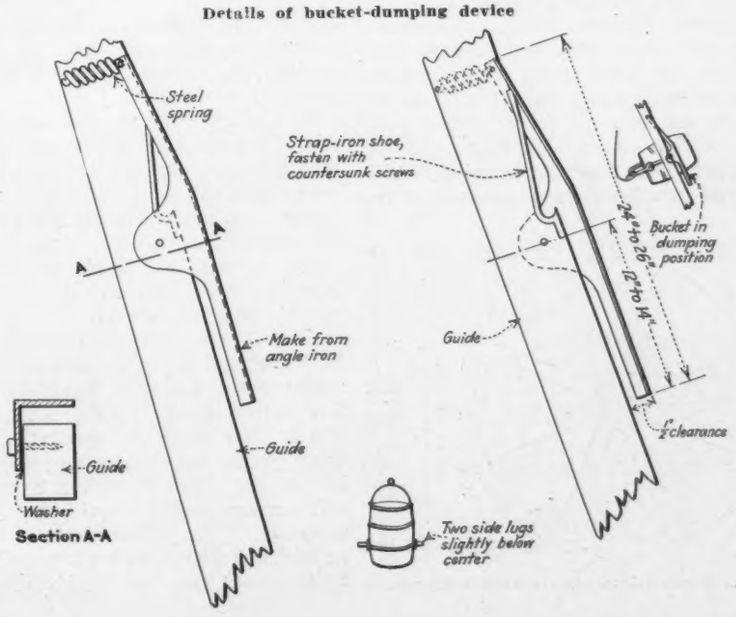
An interesting feature in the cleaning practice is the floating of quartz in the ball-mill discharge. By reducing the proportion of water, a thick and heavy pulp is maintained in the grinding mill. This is of sufficient density to float quartz, which is removed by a short revolving trommel at the discharge end of the mill. The pulp passes the screen, and the quartz particles are discharged from the open end of the trommel. An equal volume of water and barite gives a mixture with a specific gravity about equal to that of quartz. By reducing the amount of water, a mixture of a specific gravity close to three can be obtained. It thus becomes feasible to float the quartz in the ball-mill pulp.

The plant is electrically operated, receiving its power from hydro-electric transmission lines. Its capacity is 8 tons per hour. Total horsepower used is 400. At present, operated on a single-shift basis, it is producing about 75 tons per day. E. H. Murchison is superintendent in charge.

Bucket-Dumping Device for Inclined Shaft Guides

In the accompanying sketch, contributed by C. O. Newton, of Huntington Park, Calif., is shown a bucket-dumping device applicable to inclined shaft guides. The essential features of the device include a bucket with lugs, placed slightly below the center line of the bucket; notched guides; and an arrangement for retaining the bucket lugs in the notches.

Details of bucket-dumping device



Ore Hoisting in the Butte District

Part III

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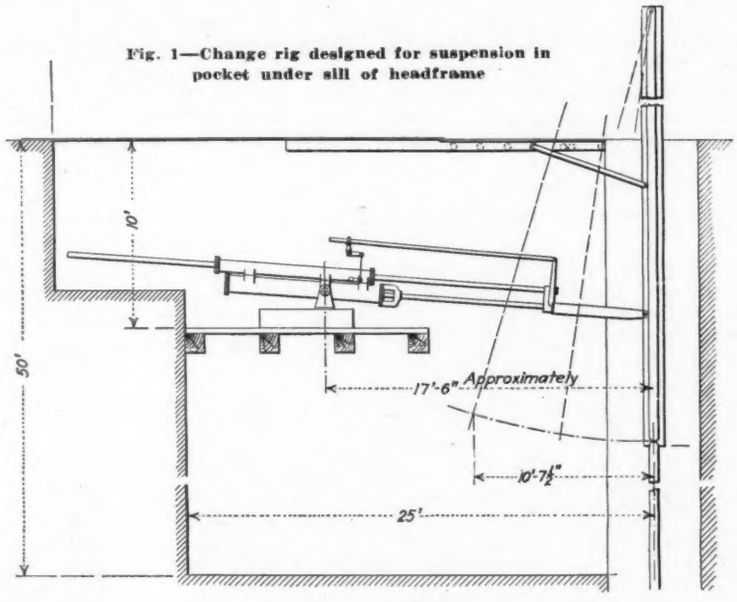
THE TYPE of "change-over" arrangement to be installed in a headframe influences the design of the structure, particularly its height. This is evident in the following discussion of the various types of change rigs in vogue in the Butte district.

Change rigs are of three general types: namely, those suspended in pockets under the sill of the headframe, those within the headframe, and those suspended from the skip dump structure. The first type is illustrated in Fig 1. Special pockets or timber compartments adjacent to the shaft are built under the floor or sill of the headframe. Fixed guides are set at an angle in the pockets so that the movable guides of the headframe can be swung into alignment with the stationary guides of the change compartments when the trip to be changed over has been hoisted above the pivoted guides. The trip is then lowered and run into its compartment. There are generally two sets of pockets, one set for each hoisting section. Two pockets are so placed, one beneath the other, that the changes are in line with the shaft section, and can be made quickly and easily.

Fig. 1—Change rig designed for suspension in pocket under sill of headframe



As shown in Fig. 1, the pivoted guides are swung by compressed air cylinders. The two lines or rays drawn from the guide pivot are the prolongation of the fixed guides in the pockets, one being beneath the other (one for cages and one for skips). The position of the shaft is indicated by the hatched portion of the drawing, which also shows the outer dimensions of the change rig pockets. The excavation is timbered and tied to the shaft proper, so that the pocket guides form radii from the guide pivot.

To change over by this method, the trip is run up above the pivoted guides; the guides are swung by compressed air into alignment with the empty change pocket; and the trip is then lowered on the shifted guides until it rests in its pocket. Next, the cable or hoisting rope is slacked off; and the clevis removed and transferred to the trip desired. This trip is then pulled out of its pocket and above the pivoted guides, which are swung into alignment with the vertical guides of the shaft. The trip is then ready for service. All of these operations, which are controlled by the top men through a system of bell communication, require but a few moments. The arrangement, which necessitates a large open pocket adjacent to the shaft, has the disadvantage of involving extra expense on account of excavation and timbering. It has, however, given excellent service wherever adopted. A few of the mines using this system are the Diamond, High Ore, Pennsylvania, and Elm Orlu.

The second type of change rig is employed at the Leonard No. 2 mine, and is the only one of its kind in the

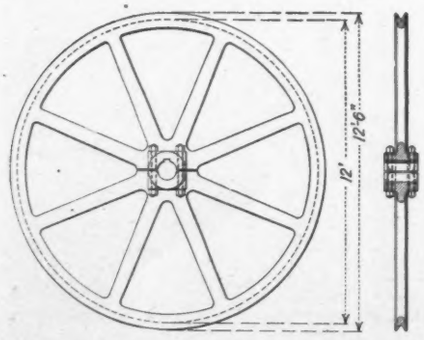


Fig. 2—Cast-iron sheave with split hub

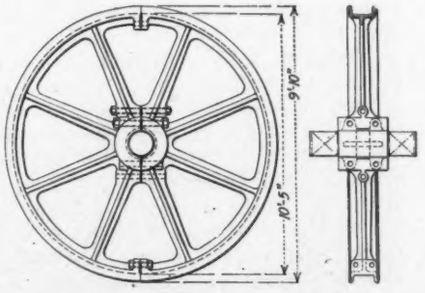


Fig. 3—Cast-iron sheave made in two sections

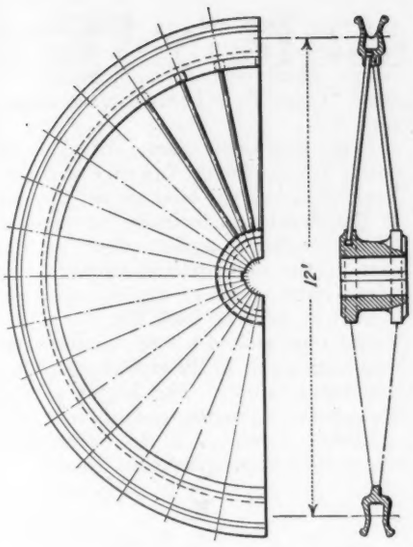


Fig. 4—"Bicycle-spoke" sheave

district. The pockets are directly within the skip-dump structure, and the swinging guides are in alignment with the change pockets. Built-up steel construction is used throughout the structure. This arrangement has the advantage of the changes' being made on the surface, and permitting the equipment always to be open for inspection and

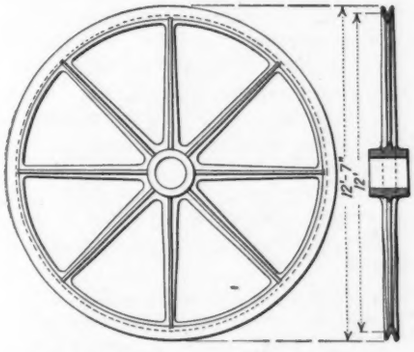


Fig. 5—Recent type of all-steel sheave

repair. Moreover, it is also a cheaper arrangement than the first. However, it necessitates a tall structure, and is therefore of limited application.

In the third arrangement, the cages and skips are suspended from special "chain-block crawls" that run on an I-beam track between the forelegs of the headframe proper and the skip-dump structure. This change rig, the details of which are relatively simple, has been adopted in the latest structures, inasmuch as it has numerous advantages and is inexpensive. A heavy I-beam is suspended from tie girders between the forelegs of the headframe and the skip-dump structure. This I-beam is equipped with racks, upon which travel special "crawls" that are used to carry the "changes" and to move them about, out of the way.

Vertical guides above the collar of the shaft are of steel, built-up section, and are hinged to swing outward. When the guides are swung out, the trip to be changed over is free to be pulled from between the guide columns. The trip is first hoisted to a point just below the "swing-out guides," which are hinged in a vertical plane. The guides are then swung out, and a top man on the superstructure, below the crawls, attaches the two crawl suspension hooks into the ears of the dog shaft of the top cage as the trip ascends. When these hooks are attached, the hoisting engineer is signaled to slack off until the full weight of the trip is taken up by the crawls. The hoisting cable is then detached from the draw bar, and, while one man changes the cable to the desired trip, the other shifts the crawl bearing the changed trip out of the way.

When the new trip has been aligned with the shaft and the cable coupled to the drawbar, the weight of the trip is taken off the crawl and the hooks are detached. The trip is then lowered and guided, so that the guide shoes will engage the vertical guides of the shaft. When the trip is low enough, the hinged guides are swung into normal position and locked. This method has the advantage of simplicity and low initial cost. Moreover, the trips are always open for inspection, repair, and quick change, should new equipment be required.

Existing steel headframe structures in the district, all of the A-type, can be segregated into three general groups, namely the built-up section group, the rolled section group, and a group consisting of a combination of the sections of the other two groups. The section chosen in design often depends on the personal preference and taste of the designer. The Leonard No. 2 structure is typical of the built-up section type. The type that veers to the opposite, the rolled section, is illustrated in the Black Rock headframe and the new structures over the Mountain Consolidated, Badger State, and Belmont mines. The first steel headframes erected in the district, those over the West Colusa and the St. Lawrence shafts, were of the rolled-section type. It is generally conceded that, strength for strength, rolled sections are lighter, easier to fabricate and paint, simpler to erect, and neater in appearance than built-up sections.

Another factor that will influence the design of the headframe is the amount of ground space available. Therefore, the ground in the vicinity of the shaft should be examined carefully for bearing power. Obstructions that may occur between the collar of the shaft and the

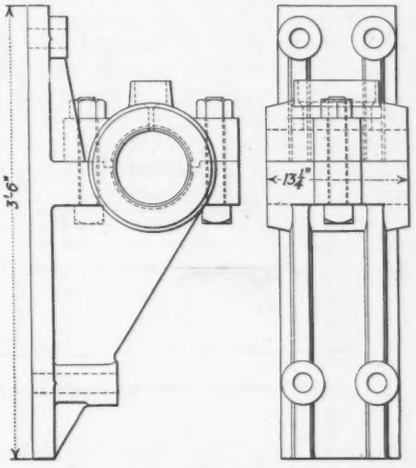


Fig. 6—Post type of sheave journal

engine room can sometimes be employed to advantage in design. Often, excavations in the upper levels of a property and the proximity of other mines cause subsidence. This frequently happens in the Butte district. Headframes have settled and have been twisted out of alignment as a result of block movement. This necessitates the use of hydraulic jacks to level up the structure after realigning it with the hoist. Special extension members are also put in place to reseat the headframe on its foundations. This settling does not mean that the foundations have necessarily become damaged. In lighter

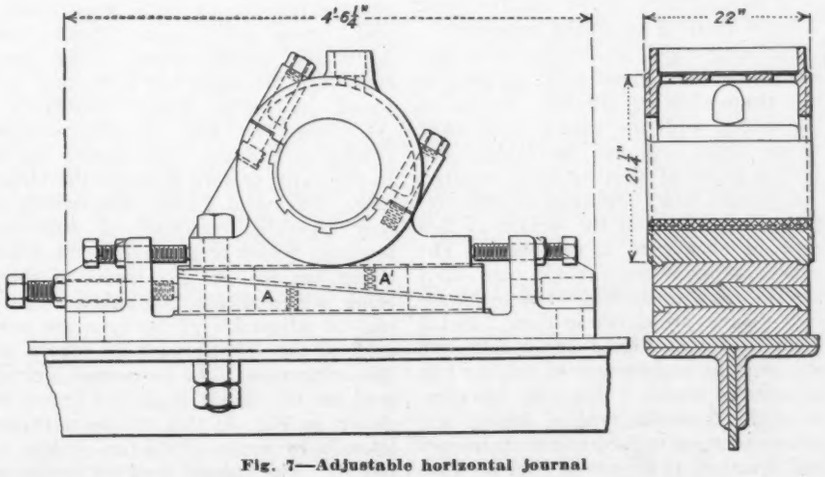


Fig. 7—Adjustable horizontal journal

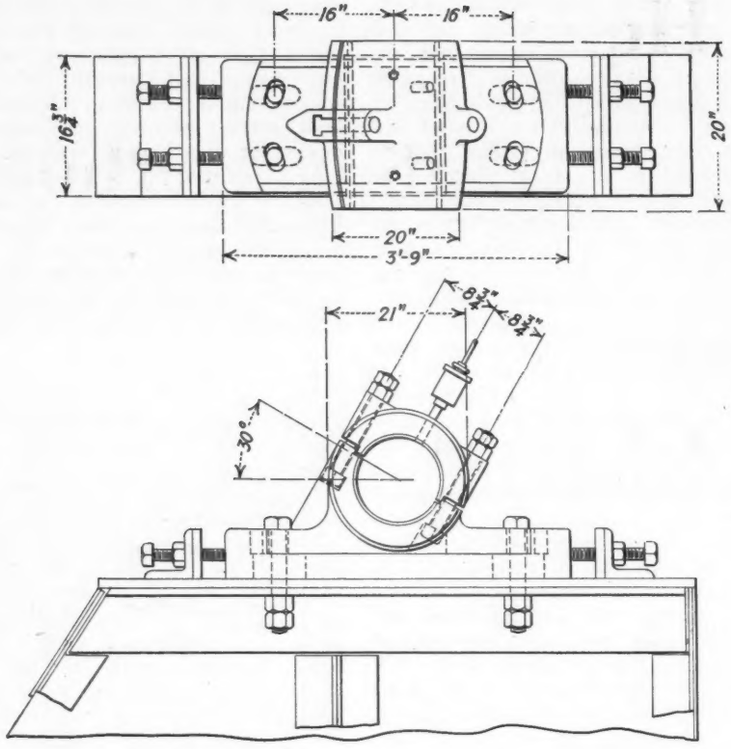


Fig. 8—Sheave journal used on the most recently erected headframes

structures than those built at Butte, such settlement might result in failure or costly distortion, but exceptionally sturdy structures are the rule in the district.

Should the terrain be unusually rough and the excavation of engine room foundations particularly costly, the engine room may be brought close to the headframe, or it may be placed a long distance away. These conditions are well illustrated in the profiles of the Mountain Consolidated and Belmont properties (see Figs. 9 and 10, Part I). In the former, firm foundations were chosen at a distance from the shaft, as the area in the vicinity of the old engine room was found unstable for greater loading. In the latter, the mine is in the city of Butte, and headframe and engine room are on opposite sides of a thoroughfare; these features made a truss housing or guard necessary.

Hoisting ropes of circular cross-section have been found most suitable in the Butte district, although several of the mines, with the engine room close to the shaft, still use flat cable. The earlier types of sheaves were massive, and of cast iron. Subsequent improvements have reduced the weight of this type of sheave to a minimum. The earlier types were shrunk onto steel shafts. Two of the older types of cast-iron sheaves are shown in Figs. 2 and 3. That shown in Fig. 2 has a split hub that permits replacement of the shaft to be effected readily. The rim, however, is solid. A similar type of sheave, cast in two sections to facilitate its transport and erection, is shown in Fig. 3. This sheave was made for both flat and round ropes.

A somewhat later development in sheaves occurred when the massive spokes were replaced with steel "bicycle" spokes. Many sheaves of this type have given good service when their casting has been favorable. This, however, is difficult to obtain. In casting this type of sheave, which is shown in Fig. 4, the spokes are set in the mold, the hub and rim being cast around them. This tends to cause burning of the spokes, unequal setting, loose spokes, and the introduction of casting strains. In the latest installations, an all-steel sheave was adopted. This sheave, shown in Fig. 5, is lighter and stronger than any of the other types, and is giving excellent service.

Sheave journals or bearings can be grouped into three general types, namely post types, solid girder types, and adjustable girder types. The post type, both the angle and horizontal, are found in many timber headframes. As shown in Fig. 6, they consist chiefly of a heavy iron casting bolted to the main or fore posts of the structure. The solid girder type, which is now obsolete, consisted of cast-iron bearings bolted or riveted to the main girder but without any means of their being adjusted for alignment. Bearings of adjustable girder type are now used to the exclusion of all others on steel structures. The horizontal journal used on the Black Rock headframe is shown in Fig. 7; this can be adjusted laterally by means of the two wedges *A* and *A'*. The journal used on the latest structures erected in the Butte district is shown in Fig. 8. In this design, the wedge adjustment is eliminated. Instead "shims" will be used when necessary.

Rope fastenings should develop, as nearly as possible, the full rope strength. Rope sockets of any kind are not favored in the district, principally on account of the prejudice against them on the part of the underground workers. A simple and readily applied loop is formed by bending back the end of the served rope around a steel thimble, and then securing it to the standing part by wire-rope clamps. The length of the lap depends upon the size of the rope, and varies from 5 to 10 ft. Seven clips above the thimble clamp the rope.

■

Chain-Drive Maintenance

FAILURE of chain drives, high upkeep costs, and delays from shutdowns may be minimized if adequate attention is paid to five maintenance rules, proposed by C. R. Weiss, chief engineer, Link-Belt Company, Indianapolis, Ind.:

Proper Alignment.—Be sure that sprocket wheels are in line on the shafts. If the sprockets are not exactly in line, a side pull develops which concentrates the load on the side of the sprocket teeth and on one side of the chain. This faulty alignment results in excessive wear on both chains and sprockets.

Correct Adjustment. — The chain should be run just a little slacker than a belt. Too much tension causes undue wear on the chain and wasteful friction on the bearings. Not enough tension, of course, may allow the chain to jump the sprockets or ride the teeth and break.

Frequent Lubrication.—The chains should be lubricated at frequent intervals. A good grade of light cylinder oil should be used. A paint brush is a good thing for applying oil to the chain joints. Paint the open joints on open (upper) side. Oil the closed joint chains on inside (upper side of lower run) while drive is running slowly.

Frequent Cleaning. — Open drives should be cleaned regularly. Take the chain off and clean it well by soaking and dipping in kerosene. Dry well, and oil it thoroughly before starting up again. Before shuting down a machine for a period of time, clean the chain and oil it with heavier oil or grease. When it is to be used again, re-clean and oil with light oil.

Well-fitting Sprockets.—Look at the sprocket wheels from time to time to make sure that they are not worn enough to injure the chain. Before the teeth are worn to a hook shape, the wheels should be replaced with accurately made and close-fitting sprocket wheels.

The Mount Hope Drilling Method

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FORTY MILES from New York, in the stopes of the Mount Hope iron mine of the Warren Foundry & Pipe Corporation, at Mount Hope, in northern New Jersey, a novel and money-saving method of drilling has been developed in the last few years. Visitors who saw it at the outset are said to have smiled. Now the management smiles, and with good reason. By its use the tonnage broken per man-shift has been increased from 15.5 to over 60. It has been an important factor in keeping the mine running without a shutdown during years when even Lake Superior mining operators have found times none too good. And there seems to be no reason why operators in other districts, where character of ground and stoping conditions permit, should not use it to advantage. Thanks to the courtesy of Mr. Leonard Peckitt, president of the company, the following details are presented:

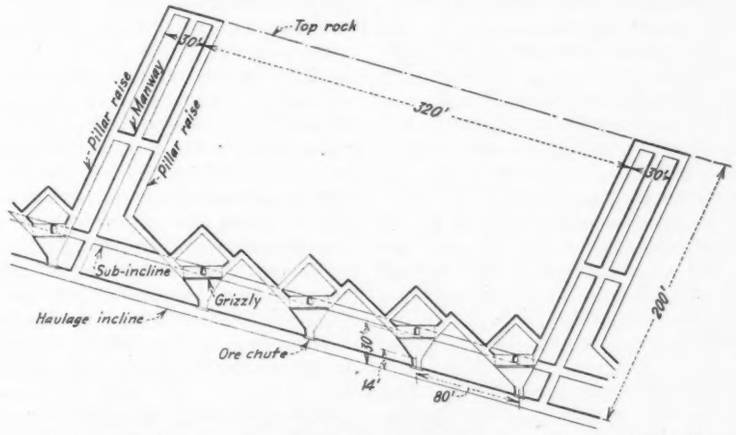


Fig. 1—Sketch showing ideal plan of stope development now followed in Mount Hope mine

Production of the Mount Hope mine is now at the rate of 17,000 tons of ore per month. During 1929, a total of 212,340 tons of ore averaging 47.75 per cent iron was hoisted. Concentrate shipped in that year totaled 150,046 tons analyzing 60.62 per cent iron, 7.96 per cent silica, and 0.522 per cent phosphorus. The average number of men employed per day in 1929 was 143, including those on top and in the mill. Of this number 88 were underground.

Geology—The ore at Mount Hope is magnetic and the wall rock gneiss. The deposits are several in number and are long and lath-shaped, each "lath" standing on edge at steep dip and pitching lengthwise at approximately 15 deg. along the strike. Measured on the dip, the deposits are with some exceptions about 200 ft. in height, the thickness varying from 5 ft. to as much as 40 ft. Average thickness is about 15 ft. In any one deposit the dip is fairly uniform. For the orebodies as a group it runs between 60 and 70 deg., in one case being as flat as 50. The strike is N. 45 deg. E. In general the deposits follow the banded structure of the gneiss. A major fault cuts them almost at right angles. Strike faults also occur. As to origin, the deposits are thought to be of the replacement type, the solutions having come from below.

Mining Method—Straight shrinkage is used, with pillars between the stopes. Prior to June, 1925, considerable ground was worked out in this fashion and is standing today without timbering and unfilled, though some sloughing of the wall rock has occurred. In general, the ground stands well. Pillars never slough before mining is completed, and consequently there is very little dilution of the ore with wall rock. Between June, 1925, and March, 1926, certain modifications now practiced were developed. This change had been preceded by an attempt to install the Latouche system of raises,[1] the impression then prevailing that the orebodies were around 45 to 50 ft. wide. So they were in spots, but much less on the average, and so the system contemplated was unsuitable.

The change made since 1925 may be said to be in drilling technique and stope preparation rather than in mining method. Today the method used is still a shrinkage system without timbering or filling, the stopes being separated by pillars. The results speak for themselves: In 1925—one of the best years under the old system—tons broken per machine shift was only 25, and per man-shift only 15.5. During 1929 one man with one drill broke 60.63 tons per shift, using 22.85 lb. of powder. Here it should be remembered that there is a great difference between "tons per man-shift" and "per machine-shift." The figure 60.63 tons per man-shift includes all labor shifts charged to breaking ore in stopes. Tons per machine-shift would be much larger.

Expressed in terms of men instead of tons the difference is quite as striking. In a certain typical stope on one shift, four men, each on a machine, now take the place of fourteen drillers, the latter number not including one pipe

Table I—Comparison of Yearly Force at Mount Hope, 1919-1929

	1919	1920	1921	1922	1923	1925	1926	1927	1928	1929
Average number of men employed per day...	307	309	235	197	229	242	193	176	160	143
Average number of men employed per Sunday and holiday	.....	.....	.....	.....	26	17	10	7	4	2
Average overtime shifts	.....	.....	.....	.....	85	116	91	38	24	25
Tons of crude ore milled	177,804	198,207	19,776	55,145	164,813	182,130	205,288	198,993	198,181	212,340
Total days of operation	249	283	37	76	256	281	295	307	302	301

[1]See A.I.M.E. Technical Publication No. 20, "The Latouche System of Mining as Developed at the Beatson Mine, Kennecott Copper Corporation, Alaska." By Bevan Presley.

man on each shift. The effect of the change is strikingly shown in the accompanying Table I, entitled "Comparison of Yearly Force at Mount Hope." Of the four men, two are at each end of the stope, the two groups working toward each other. Each man in a group assists the other in making the novel set-up employed, hereafter to be described. Each group does its own blasting and pipe work. All four men are on a contract basis (ground broken being calculated from surveyor's measurements) after they have earned day's wages.

The method of drilling differs radically from that previously employed. The old method involved the familiar practice of setting up stoping machines at more or less steep angles with the leg end on the muckpile and drilling holes 5 ft. deep in the back. Drilling in this way, a cut or slice 3 ft. thick was taken the full length and width of the stope and then another was begun, just enough ore being drawn off each time to allow the men to work. This method of placing the holes served to shake up the ground considerably and required that the driller stand almost directly beneath it. At the same time it permitted only holes of short or moderate length. Further, the men, being numerous, impeded one anothers' work.

Under the new method, a jackhammer provided with a standard stoper leg is first substituted for the stoper. The stoper leg differs from the ordinary kind only in that it has a 1½-in. air connection, whereby compressed air may be admitted into the shell in which the extension slides. This connection is tapped into the side of the shell at its head end. Through it air is bypassed into the shell from the air hose at a point close to the drill. The bypass has a valve controlling the flow of air. Thus, by turning this valve, air may be admitted into the shell, forcing the extension out up to its full length and thereby pushing the jackhammer and its steel ahead if the end of the leg be braced against something stationary. Air within the shell may be released by means of a ¼-in. petcock, which is likewise tapped into the side of the shell close to the air connection. The stoper leg, thus equipped, serves as a drill-feeding device which is used to good effect in connection with the novel mounting employed.

Old method of drilling in stopes, now abandoned. Machines were set at steep angles with leg end on the muck pile

Before describing this mounting, it should be said that, under the shrinkage method used, stoping is conducted from both ends toward the middle and a 10-ft. slice or bench broken down the full width and length of the stope. Sixteen-foot rounds of flat or almost flat (rarely steeper than 30 deg.) holes are used. To support the jackhammer and its air-feeder stoper leg and steel in such position, the drill is laid (with the end of the stoper leg firmly held) on a 12-ft. length of 2x10-in. plank, which is set up with one end against the face and the other end on the muck at the desired angle. The plank is firmly braced. Its front end is held at the proper point for collaring the hole by resting it on one rung of a short length of ladder stood on the muck against the face. The height of this ladder may be readily changed so that drilling may be done at any degree of slope desired. The rear end of the plank is rested on the muck (and braced with pieces of ore) or is supported on one rung of another short length of ladder held upright in the broken ore in some convenient way. Such a set-up requires five to ten minutes to arrange.

To hold the end of the stoper leg immovable when the drill is thus lying on the plank, the ring of a ring bolt is slipped over it and the bolt end inserted in a hole drilled through the plank. For this purpose a row of such holes a foot apart is drilled on the middle line of the plank. For starting a hole, a steel 6-ft. or longer is used. The ring bolt holding the leg is inserted in the proper hole in the plank so that the steel just reaches the face. Drilling is then started, the feed being controlled by the bypass air valve. When the stoper leg extension has run out its full length (about 2 ft.) the petcock is opened to release the air, the extension leg pushed in, and the ring bolt shifted along the plank to another hole. The drilling operation is then repeated until the hole is so deep that a longer steel must be inserted. Usually the driller finds it convenient to shift the ring bolt for every foot advanced.

The first rock drills to be used in

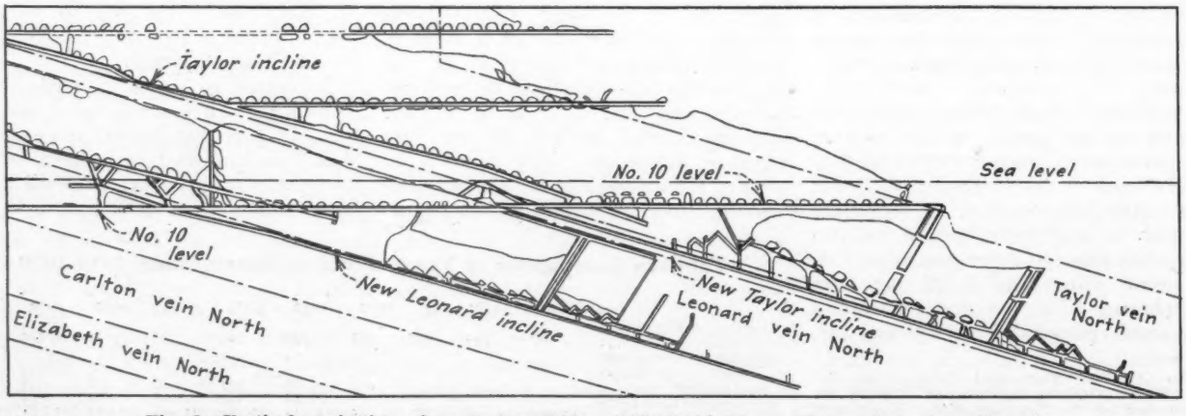


Fig. 2—Vertical projection of part of workings, 1,000 level, Mount Hope mine, at north end, showing Taylor and Leonard orebodies

A typical set-up for drilling in a Mount Hope stope, with the new method using jackhammer drill and air-feed stoper leg

this way were Denver 39 jackhammers. These are being replaced with I-R 49 machines, both types being now in service. Steel is 1-in. hollow hex. It is provided in 6-, 8-, 10-, 12-, 14-, and 16-ft. lengths, although the set (of lengths) used for any one hole will vary with the ground. An 8-ft. length or a longer one may be used at times for starting. The gage of cross bit used ranges from 2 in. to 1½-in., depending on the length of steel. Drilling may be wet or dry, though the men prefer the latter as being faster even though dustier. Air-line oilers, filled by the machine men from gallon cans, are used to lubricate the drills. Air pressure is 80 lb. at the machine.

Usually the maximum burden on the hole is about 8 ft. In a stope 15 ft. wide, two rows of four holes each generally suffice to break the bench. The holes "kick out" ahead, a 16-ft. hole often breaking 18 to 20 ft.

Under the drilling practice described, the driller is always in comparative safety. The use of horizontal or slightly inclined holes put in ahead of him instead of over his head tends to disturb the rather treacherous ground to a less extent than with the earlier method, and at the same time permits advantage to be taken of the frequent horizontal partings in the ore.

Accidents have decreased since the new procedure was adopted. An explanation of the highly efficient results obtained is to be found in the simple procedure, the small number of men employed, and the absence of heavy machines and columns which would otherwise have to be handled.

Blasting in the stope is done by the drillers, the two men in each end helping each other. Giant 40 per cent gelatin in 1⅛x7-in. sticks (a special size that runs 130 to the 50-lb. box) is used, with No. 8 caps and ordinary fuse.

At the beginning of each shift, steel, tools, and drills are lowered down the pillar raise at the end of the stope (see Fig. 1), through which access to the stope is had. A small wooden skip running on the ladder as a track, and operated by a portable air hoist with a ⅜-in. rope, is used for this purpose. All heavy lifting and carrying is thus avoided.

Thus far in this article, because of the unique character of the drilling practice in the stopes, I have discussed it before attempting to describe the work of exploration, development, and stope preparation which precede stoping. These latter topics will now receive attention.

Exploration — Underground exploration was formerly done by driving prospect drifts and raises. Considerable money was thus spent up to within the last two years. However, diamond drilling, done under contract by an outside firm, has proved superior. In the eight months during which this practice has been in vogue a total of 4,000 ft. of 1¾-in. hole has been drilled from various underground points. The contract price is $3.90 per foot, the mining company furnishing air and water, which is equivalent to possibly another dollar per foot. A log of each hole is kept. Each hole is likewise tested for vertical angle every 100 ft. with hydrofluoric acid. So satisfactory has this core drilling been that the management is now relying on the data it affords for extending its knowledge of the ore deposits. It is now drilling for the Teabo orebody (500 ft. high), known to exist within its boundaries, and for the much larger Mount Pleasant deposit (1,800 ft. high). In estimating tonnage of broken ore, a factor of 8.6 cu.ft. per ton is taken.

Development — In charging costs, only the main haulageways are classed as development. All work connected with opening a stope, save the haulageway, is charged to stope preparation.

The property is opened by one main shaft, known as the Brown, sunk at 68 deg. to the main haulage level at 1,000-ft. elevation. Ore drawn from chutes below this level reaches it via an auxiliary hoisting system consisting of single-track skip roads on three inclines driven at small angles to the horizontal. These inclines deliver each to a 200-ton raise pocket at a point about 50 ft. above the haulage level.

The main shaft is 16x6 ft. in the clear, has two 5½x6-ft. skipways and a manway, and is concreted for the first 75 ft., being timbered with stulls below this point to the fourth level and with

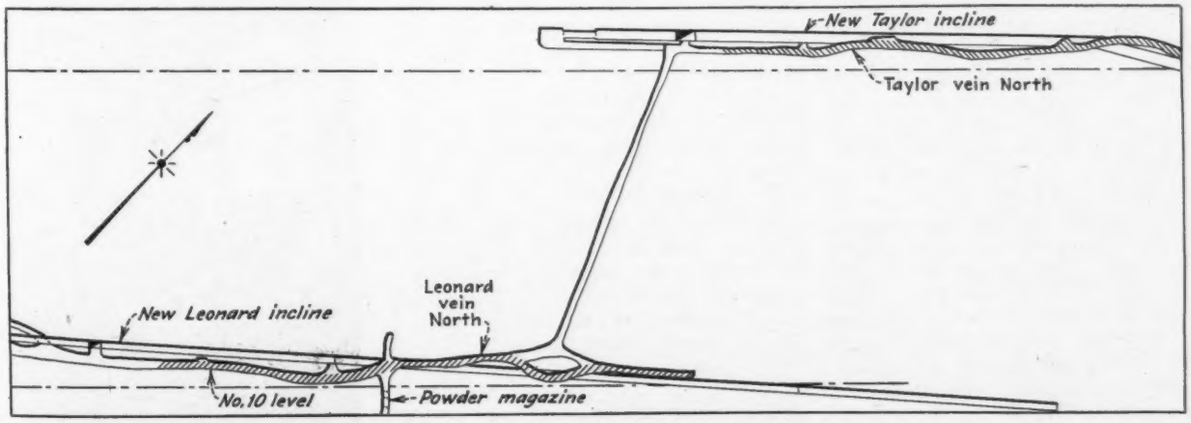


Fig. 3—Horizontal projection of part of workings on 1,000 level at north end, showing Taylor and Leonard orebodies (not identical with Fig. 2)

square-sets from the fourth to the bottom. In addition to this shaft, an emergency exit, consisting of ladderway only, connects the third level with the surface.

Jackhammer drill, with air-feed stoper leg

Auxiliary inclines are sunk in footwall rock in each case (see sketch in Fig. 1). An effort is made to have the stope chutes on the footwall and the corresponding grizzlies directly on the contact. Below the 1,000 level, one incline, 1,700 ft. long, runs at 15 deg. under the Taylor orebody, and another, 1,000 ft. in length, runs beneath the Leonard body at 13 deg. The remaining one, driven beneath the Elizabeth orebody at 15 deg., is 940 ft. long below the 1,000 level and 1,300 ft. above the 1,000 level. These inclines are driven 8x10 ft. in the clear, and are untimbered. In general, they are advanced by sinking, the full width being carried in one operation. Ingersoll-Rand N75 water Leyners, mounted on bars, are used, with $1\frac{1}{4}$-in. hollow-round steel. The cost of sinking is estimated approximately at $12 per ft. on contract, including drilling, mucking, powder, fuse and caps. At present, raising is in progress on one incline.

Stope Preparation — Stopes are laid out 320 ft. in length with 30-ft. pillars between. Their width is that of the deposit, varying from less than 10 to 35 ft. (averaging 15 ft.) They are carried the full height of the orebody, which in deposits now worked does not exceed 200 ft. In all present instances they are carried up to the capping without intermediate levels, the main haulageway or one of the three inclines running directly underneath as previously described.

To prepare a stope for mining, a series of chute raises and grizzly chambers is first provided just above the haulageway to which the ore stoped will be delivered. Moreover, to give access to the stope while mining, a working raise is put up at each end next to the pillar, and in the pillar itself is driven a manway which communicates with the working raises.

The chute raises are started on the contact from the back of the haulageway, which is preferably just within the footwall. They are driven 5x6 ft. in the clear at 80-ft. intervals. At a point 14 ft. above the rail each chute raise branches into two raises, each branch having the same dimensions. The two branches are driven upward at an angle of 45 to 50 deg. in opposite directions along the strike. These so-called "cone" raises are continued until they intersect with those driven from the adjacent chute raises. The ground above each chute between the two branching raises is now broken down, and at a point 30 ft. above the rail a grizzly, 8 ft. wide and 26 ft. along the strike, is constructed, centered on and directly above the chute. Estimates indicate that the cost of chute raises is $7.50 per foot, including everything. The grizzly consists of 120-lb. new (seconds) rails, upside down and spaced 11 in. in the clear, supported on four 12x12-in. timbers. The rails lie parallel to the long side of the grizzly. One of the timbers is at each end of the grizzly opening. The remaining two are in the middle, one on top of the other, the top of the upper one being 6 in. lower than the end timbers, so that the two halves of the grizzly slope toward the center. The timbers rest in hitches in the rock and are themselves notched to admit the rails for the full width and depth of the latter. In the middle timber the ends of the rails of the two halves of the grizzly abut on each other. Quarter-inch steel plate (old) is used to protect the top of the timbers and their vertical faces between the rails.

The pillar manway and the end or working raises, put up at the outset to give access to the stopes after mining has begun, are driven in the following manner: The manway, untimbered and 4x6 ft. in section, is driven in the center of the 30-ft. pillar left between the stopes and is carried up to the top of the orebody in one continuous operation. At the same time, at each end of the stope immediately next to the pillar, an end or working raise is driven. It is of the same size and length as the manway. Pillar raise and working raise are now connected at midpoint and at top by means of short drifts through the pillar. Later, when stoping has begun, the miners, to reach their working places with their tools and supplies, ascend the manway either to the mid point or to the top, according to the height of the broken ore in the stope, and, passing through the connecting drift, descend the working raise. Steel and supplies are hoisted up the manway and lowered down into the stope through the working raise by means of a Little Tugger hoist located in the connecting drift. For this purpose a small wooden skip on a $\frac{3}{8}$-in. wire rope is provided. It slides on the ladders as a skipway and has cleats on its under side to keep it from jumping the improvised track.

According to estimates, the cost of manway raises and of the end or working raises in the stopes is $9 per foot, everything included. This is higher than the cost of the chute raises, because of the greater height.

Extraction is high under the mining method used. The stope pillars are allowed to remain, but the ore left to protect the grizzlies and the haulageway is eventually recovered after the stope has been completed and the broken ore drawn off.

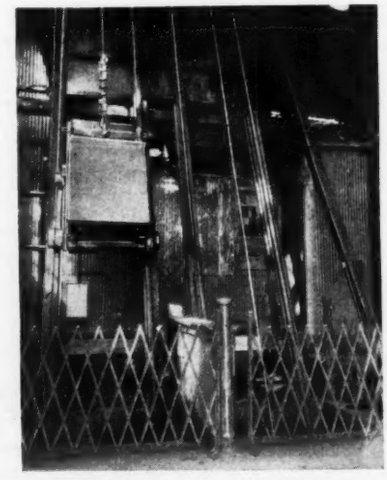
Stope preparation being now completed, stoping is begun. A pillar has previously been cut out and left above each grizzly. The inverted cones between the raises are now broken down, the work being conducted from the raises. As soon as a roughly horizontal back is established, systematic stoping proceeds, as previously described, by breaking down a 10-ft. bench for the full width and length of the stope.

The stope chutes have posts 10x10 in. in size and 16 ft. long, and are 3 ft. high and 4 ft. wide in the throat. The apron is sheathed with $\frac{3}{8}$-in. plate. Arc gates, 5 ft. wide and 24 in. on the curve, and reinforced with old 35-lb. rails are used, being counterweighted with old car wheels. The gate opens by moving downward.

Bulldozing or blockholing is done at the grizzlies, at each of which one man with a plugger drill is kept busy on this task, if ore is being trammed. Corresponding to the fact that five-sevenths of the daily tonnage is trammed on afternoon shift, the number of grizzly men is eight on that shift, compared with two on day shift. In 1929 the cost of powder for blockholing was $0.003 (3 mills) per long ton.

Blasting in stopes has already been described. The same powder—40 per cent gelatin in $1\frac{1}{8}$x7-in. sticks, counting 130 to the 50-lb. case — is used with No. 8 caps and ordinary fuse throughout the mine. "Wooden" powder is used in raises as a device to promote economy, the sticks being of the same size as the gelatin. Two sticks of the latter are put in the bottom and thereafter a stick of wood and a stick of gelatin out to the collar. No stemming is used in the raises. In general, drillers do their own blasting.

An underground magazine built according to U. S. Bureau of Mines suggestions is maintained. It is kept at a uniform temperature with an electric three-strip heater. One man, who



Collar of Brown or main shaft

prepares all primers (2 to 10 ft. long) and issues explosives only on the shift boss' requisition, is kept on duty on day shift at the magazine.

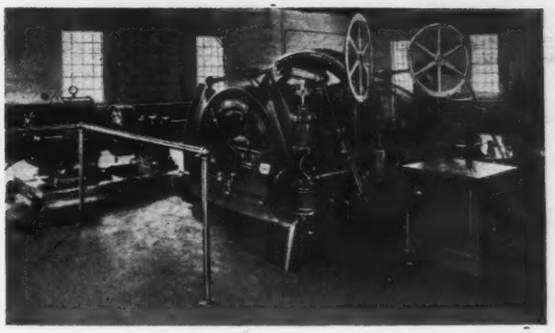
Hoisting and Underground Transportation System — The main shaft is equipped with two 2½-ton skips, hung on 1¼-in. Blue-Center wire rope and running on a track of 48-in. gage. Hoisting is done with a first-motion two-drum W-S-M hoist, direct-connected to two 125-hp. motors. Lilly control is provided; also automatic shut-off and devices to prevent overwinding. The drums may be used out of balance. Made originally to hold 600 ft. of rope, they are actually winding approximately 1,100 ft. Ropes are inspected three times weekly and are lubricated once a fortnight with cable grease applied in a trough that is fitted around each rope just below the 6-ft. cast-steel sheave. Unless inspection shows defects, ropes are replaced by new ones regularly once a year, and are transferred to the inclines where service is naturally less severe.

Auxiliary hoisting in each incline is done in a 4-ton skip, running on a 48-in. track and having chilled-tread skip wheels with plain bearings. Rails of 56-lb. weight are used in the inclines, compared with rails of 35-lb. weight and 26-in. gage track in the main haulageway. Incline skips are loaded directly from the stope chutes which overhang them. When sinking is in progress, they are loaded in the heading by hand mucking with three men.

Main haulage transportation to the shaft is effected by a total of thirteen Granby-type ore cars of special heavy construction, each weighing approximately 3 tons and holding 4½ tons of ore. These are operated seven to a trip, hauled by a 6½-ton Westinghouse trolley locomotive using 250 volts d.c. There are two of these locomotives. Average motor haul is 1,500 ft. and the maximum 3,750 ft. Great advantage and economies have been afforded by these cars, principally because of the low cost of maintaining them. A trip may be handled by one man, but for safety the motorman has a helper, the two-man crew performing the entire operation of loading, hauling, and dumping into the shaft pocket.

Most of the tramming is done on afternoon shift, when 500 of the approximately 700 tons hoisted daily is trammed to the shaft. The remainder is handled on day shift. All stoping is done on day shift.

The cost of car loading, including labor only, was $0.024 per long ton in 1929. Maintenance cost of cars in the same year was $0.011 per long ton, compared with a cost of $0.044 per ton hoisted in 1925, for maintaining the 2½-ton gable-bottom cars then used for the same purpose. This difference of over 3c. per ton is explained by the fact that in 1925 two men were steadily employed at $9.84 per day on repairing



Hoist at Brown shaft

the gable-bottom cars, whereas the Granby-type cars that have replaced the latter are so strongly built that all the repair and maintenance work necessary is done by one man on day shift, who also repairs drills, Tugger hoists, and other equipment. The cost of the gable-bottom cars was $350 each, whereas the Granby car used could be built for approximately $500 each. Besides their advantage of long life, the Granby cars require less labor in dumping and can be handled with fewer minor accidents.

Cost of Delivering 1 Ton of Ore to Surface. Mount Hope Mine, 1929

	Cost	Per Cent
Total underground labor	$0.800	57.19
Supervision	0.043	3.07
Compressor, air drills, drill steel	0.109	7.79
Power	0.138	9.87
Explosives	0.158	11.29
Other supplies	0.151	10.79
Totals	$1.399	100.00

Steel Sharpening — This is done underground; likewise drill repairing. An I-R No. 50 sharpener is used with an oil-fired forge. Shanks are quenched in No. 2 Houghton oil and the bits in water. In 1929, 108,200 pieces of steel were handled in the shop, a daily average of 359.46. Average number of pieces (sharpened) per man-hour was 11.19. Average cost of blacksmith work per piece was 0.082c. Total pounds of new steel placed in service in 1929 was 32,628.

Thirty drills are in service, including those on blockholing. A few spares only are kept on hand and the number of parts is held to a minimum. These are purchased from the manufacturer.

Ventilation and Drainage — The workings are well ventilated by natural means. Mechanical ventilation is limited to one small portable fan driven by a 5-hp. motor and discharging through 800 ft. of 12-in. Ventube.

Most of the mine water drains into a 200,000-gal. sump on the 1,000-ft. level, from which point a 300-g.p.m. Aldrich triplex pump lifts it to the fourth level, to be pumped to surface by another Aldrich at this intermediate point. On surface, the water is used at the power plant for cooling the compressors. A small amount of water is made below the 1,000-ft. level and is raised to the latter by air-driven pumps of small capacity.

Cost of Labor, 1929, Per Ton

(Man-hours per Ton on Property, 1.571)

	Cost	Per Cent
Breaking (drilling and blasting)	$0.312	37.02
Mucking	0.068	8.06
Haulage and hoisting	0.345	40.92
Supervision	0.043	5.10
General	0.075	8.90
Total labor underground	$0.843	100.00

In 1929, a total of 37,000,000 gal. was pumped to surface. Pumping is done on day shift only on the 1,000-ft. level and on two shifts on the fourth level. No pumping is done on Sunday.

Labor — Approximately the same force is employed today as in 1929, when the daily underground payroll averaged 88 and the total payroll 143. Average tonnage of crude ore hoisted in 1929 was 705, or 4.937 tons for every man on the property, or 7.976 tons per man underground.

The mine force works in two eight-hour shifts, from 7 a.m. to 3 p.m. and from 3 to 11 p.m. As previously explained, all drilling is done on day shift and five-sevenths of the tramming on night shift. Of the 88 men underground, 22, including a pump man, are on the night shift.

Cost of Power and Supplies, 1929, Per Ton

	Cost
Explosives (0.377 lb. per ton)	$0.158
Total power (horsepower-hours per ton)	0.215
Air compressing	0.073
Hoisting	0.065
Pumping	0.062
Haulage (including lighting)	0.015
Supplies and power per cent of total cost, 26.66	

The wage scale is $5.20 per day for miners and timbermen (in general for anyone who handles powder) and $4.64 for shovelers, including roustabouts and helpers. (Of actual shoveling, comparatively little is required.) A shoveler or helper is never allowed to handle powder. An effort is made to contract all rock work wherever possible except in the case of timbering. Pipemen, of whom there are two, without helpers, receive $5.20 per day, as does the single trackman, who also works without a helper.

Digest of Current Technical Literature

Selected from abstracts of articles in the leading technical periodicals, prepared by Engineering Index Service, American Society of Mechanical Engineers, 29 West 39th St., New York, N. Y.

Pumps, Centrifugal: Corrosion—Corrosion in Centrifugal Pumps. C. H. S. Tupholme. *Power Plant Eng.,* Vol. 34, No. 10, May 15, 1930.
DISCUSSION of chemical, mechanical, and electrolytic changes that cause trouble.—E.I.S., New York.

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Copper-Ore Treatment: Mexico—Ore-treatment plant of Cananea Consolidated Copper Company in Cananea, Sonora. C. Bruchhold. *Boletin Minero,* Vol. 28, No. 6, Dec., 1929.
DESCRIPTION of location, nature of ores, plant, flotation process, and operating details; flow sheets; layout.—E.I.S., New York.

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Mines and Mining: Aerial Transportation—Aircraft's Importance to Mining Industry. R. Joyce. *Min. Rev.,* Vol. 32, No. 7, April 15, 1930.
BRIEF article, dealing largely with activities in western Canada and elsewhere, featuring use of Boeing airplanes with 425-hp. Wasp engines, capable of speed of 133 miles per hour and rate of climb of 1,000 ft. per minute.—E.I.S., New York.

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Lead Metallurgy: Shaft Furnaces — Rationalization in Design of Shaft Furnaces for Treatment of Lead Ore. N. C. Kyriacou. *Revue de Métallurgie,* Vol. 27, No. 3, March, 1930.
PRELIMINARY study of smelting of lead ore in shaft furnaces; determination of ideal fuel and method of firing; heat losses and their recovery.—E.I.S., New York.

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Rubber Machinery: Anti-Friction Bearings — The Application of Anti-Friction Bearings to General Plant Equipment. L. M. Klinedinst. *India Rubber World,* Vol. 82, No. 2, May 1, 1930.
MOST important benefits arising are: assurance of continuity of service; reduction in lubrication expense; reduction in maintenance and materials handling equipment.—E.I.S., New York.

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Silver Mines and Mining: Mexico — Xitinga Mine, of Chontalpan y Anexas Mining Company. M. Lopez Nunyez. *Boletin Minera,* Vol. 28, No. 6, Dec., 1929.
MINE located in town of Tetipac, Alarcon district, State of Guerrero; accessible via Naranjo railroad station; claims and areas; history, geology; quartz veins in andesite and overlying slates; equipment; development; reserves estimated as 285,000 tons ore averaging 800 grams silver per ton; ventilation; drainage; production is variable; cost data.—E.I.S., New York.

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Silver Ore Treatment: Mexico—Milling Practice at Fresnillo. R. E. Byler. *Min. Mag.,* Vol. 42, No. 3, March, 1930.
SILVER-LEAD-ZINC mines in State of Zacatecas; cyanidation of oxidized silver ore; concentration of lead-silver-zinc sulphide ore by differential flotation; manganese-silver ores are treated in special plant, in which oxides of manganese are dissolved out by sulphurous acid and silver is left in form amenable to cyaniding; this process, developed by S. T. McCluskey, increases extraction of silver 20 per cent over that obtained by straight cyanidation; flow sheets; reagent and power consumption.—E.I.S., New York.

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Tin Industry: Malaya — The Malayan Tin Position. B. Somerset. *Metal Industry,* Vol. 36, No. 17, April 25, 1930.
FEDERATED MALAY STATES is richest tin-bearing country in world, producing approximately one-third of world's total supply; comparison of tin ore won by European and Chinese mines; practically all known methods of mining for tin are in vogue, and these can be divided into six heads: open-cast mining, gravel pumping, hydraulicking, dredging, shafting (lode and alluvial), dulang or panning. Comparison of tin ore won by various methods in last half 1929; statistics.—E.I.S., New York.

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Copper Deposits: French Sudan—Occurrence of Copper in French West Sudan. R. Furon. *Academie des Sciences—Comptes Rendus,* Vol. 190, No. 6, Feb. 10, 1930.
IN FRENCH WEST SUDAN in region between Sirakoro and Sei, copper-bearing minerals as malachite and chrysocolla were found; mineral content of grit-stone banks is about 12 per cent (calculated as copper); geological description.—E.I.S., New York.

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Blasting—Difficult Blasting Operation at Immenreuth Basalt Works, Winterstein. *Quarry and Surveyors' and Contractors' Jl.,* Vol. 35, No. 398, April, 1930.
BLASTING described was carried out by Kloster-Lechfeld Explosive Works with 17,930 lb. charge of Chloratite 2.—E.I.S., New York.

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Tin Dredging: Malaya—Deep Dredging in Malaya. F. G. Payne. *Min. Mag.,* Vol. 42, No. 2, Feb., 1930.
DESCRIPTION of special problems associated with design of dredge for recovering tin concentrate from alluvial deposits.—E.I.S., New York.

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Ore Treatment—The Relative Efficiency of Ore-Dressing Processes. R. T. Hancock. *Min. Mag.,* Vol. 42, No. 1, Jan., 1930.
DESCRIPTION of new formula for calculating efficiencies of ore-dressing processes.—E.I.S., New York.

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Locomotives, Mine: Benzol — Safety Measures in Use of Benzol Mine Locomotives. Chandesris. *Revue de l'Industrie Minerale,* No. 219, Feb. 1, 1930.
QUESTION of safety in use of benzol locomotives in underground coal mines is discussed, and necessary precautionary measures are recommended; in Germany these locomotives are widely used; particularly in Saare district mines they are one of the principal modes of traction; present work is based on observations made in these mines.—E.I.S., New York.

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Pumping Equipment—Automatic Mine Water Pumping. T. L. Farnham. *Coal Min.,* Vol. 7, No. 5, May, 1930.
COMMENT on practice of pumping at night when other electric demands are light, to reduce peak load to minimum; current saving is sometimes offset by labor cost of night pump runners; discussion of advantages of automatic control; description of system and equipment developed by pump manufacturer in Pennsylvania.—E.I.S., New York.

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Mine Hoists: Brakes—Brake Lining of Asbestos. Maercks. *Bergbau,* Vol. 43, No. 15, April 10, 1930.
REPORT of tests made to determine quality of asbestos as brake lining; tests show that lining is heat-resistant and has high friction coefficient (0.35 under most unfavorable conditions) and can be used in place of wood lining.—E.I.S., New York.

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Lead-Zinc Ore Treatment: Flotation—Treatment of Old Mill Tailings by Flotation. C. Bruchhold. *Boletin Minero,* Vol. 28, No. 4, Oct., 1929.
NOTES on plant of San Nicolas Mining & Milling Company at Vacas, Durango; old mill tailing pile has about 218,000 tons of oxide and sulphide material, more or less caked and cemented by exposure; average content of material treated during three months of 1929 was 212 grams silver per ton, 3.4 per cent lead, and 8.2 per cent zinc; flow sheet, operation, and equipment are described; milling cost, $2.17 per ton.—E.I.S., New York.

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Gold Mines and Mining: Surface Plants—Modern Mechanical Ore-Handling Equipment at Eureka Standard. M. D. Paine. *Min. Rev.,* Vol. 32, No. 6, March 30, 1930.
BRIEF NOTES on equipment at new shaft of subsidiary of Tintic Standard Mining Company, one mile south of Dividend, in Tintic mining district, Utah; electric hoist, steel headframe, steel ore bin, conveyor belt, air compressor.—E.I.S., New York.

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Silver Mines and Mining: Mexico — Operating Methods Used in Sulphide Zone of Proanyo Mines, in Fresnillo, Zacatecas. E. Villafanya. *Boletin Minero,* Vol. 28, No. 6, Dec., 1929.
MINES near city of Fresnillo, formerly worked as unit of Mexican Corporation; no changes made in personnel or organization when taken over by Fresnillo company; large-scale operation permits mining of ore with only 180 grams silver per ton; discussion of underhand, overhand, and shrinkage stoping.—E.I.S., New York.

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Accident Prevention—Accident Prevention Work at the Copper Range Company Mines. A. Mendelsohn. *Lake Superior Min. Inst.—Proc.,* Vol. 27, 1929.
BRIEF notes indicating favorable results obtained since aggressive campaign against underground accidents was started in July, 1927.—E.I.S., New York.

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Clay: Bleaching—Comparison of Decolorizing Power of Russian and Foreign Clays. V. Tokmanov. *Azerbayjanskoye Nephtyanoye Khozyaistvo,* No. 1, Jan., 1930.
STUDY of bleaching power of several adsorptive clays of Russian origin; clays are arranged in order of their activity with reference to ozokerite tars and asphalts; properties and methods of preparation of these clays.—E.I.S., New York.

Electric Locomotives: Mine — Modern Haulage Locomotives. D. E. Renshaw. *Elec. Jl.*, Vol. 27, No. 5, May, 1930.

IMPORTANCE of economy in mine haulage costs; description of 13-ton locomotive of Houston Collieries Company with two 90-hp. motors and 30-ton locomotive of New River and Pocahontas Consolidated Coal Company with three 112-hp. motors and other large main haulage locomotives, designed for long service and requiring minimum maintenance.—E.I.S., New York.

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Rock Drilling: Dust Collectors — Sgonina Patented Dust Trap for Hammer Drills. *Iron and Coal Trades Rev.*, Vol. 120, No. 3241, April 11, 1930.

DESCRIPTION of apparatus manufactured by Compressed Air, Ltd., of Cardiff, Wales; weighs 9 lb. complete with filter bag; air jet with ☆ in. hole injects into filter bag dust blown out of hole by air passing down hollow drill; apparatus has passed all Mines Department tests and is approved for use in silica rock; is used in coal mines of South Wales.—E.I.S., New York.

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Ore-Crushing Machinery: Rolls — Influence of Varying Speed of Crushing Roll on Quality of Product and Power Consumption. C. A. Landegren. *Jernkontorets Annaler*, Vol. 114, No. 4, 1930.

EXPERIMENTS were made using quartz ore as material to be crushed; results obtained are discussed; most uniform product was obtained with crushing ratio not exceeding 2 to 1; experiments showed that speed corresponding to Argall's equation was most economical.—E.I.S., New York.

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Copper Smelting: Spain — Present-day Smelting Practice at Rio Tinto. H. R. Potts. *Instn. Min and Met.—Trans.*, Vol. 38, 1928-1929.

BLAST-FURNACE equipment; settlers; refractories used in furnaces and settlers; furnace practice; converter equipment and practice; about 400 men employed. Article indexed in Engineering Index, 1929, p. 523.—E.I.S., New York.

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Zinc Ore Treatment: Electrolytic—Germanium in Relation to Electrolytic Zinc Production. U. C. Tainton and E. T. Clayton. *Am Electrochem. Soc.*, May 29-31, 1930

CERTAIN impurities on zinc solution, if not removed, will deposit with zinc and lower overvoltage below critical point; germanium may be absorbed and removed from solution by means of ferric hydrate precipitated by zinc oxide in leaching operation.—E.I.S., New York.

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Silver Mines and Mining: Mexico — Santiago Mine, property of Santiago y Anexas Mining Company. M. Lopez Nunyez. *Boletin Minero*, Vol. 28, No. 4, Oct., 1929.

MINE in Huautla district, State of Morelos; accessible via Tlaquiltenango station; claims and areas; history, geology; faulted quartz veins in diorites and andesite porphyry; lenticular orebodies; equipment; development; 25,000 tons developed ore, with 1,500 grams silver per ton, 16 per cent lead, and 4.5 per cent zinc; production data; costs are too high; exact costs not stated.—E.I.S., New York.

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Indium—Recovery by Electrodeposition. L. R. Westbrook. *Am. Electrochem. Soc.*, No. 57-22, May 29-31, 1930.

COMPARATIVELY rare element indium is found in very small amounts in process residues obtained in purification of crude liquors made from zinc cinder or blende containing traces of it; by treating crude liquors with metallic zinc, indium if present is precipitated out; over one pound of metal was recovered from residues for experimental purposes.—E.I.S., New York.

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Non-Ferrous Metals: Handbook—"NON-FERROUS METALS" was published by German Metallographic Society and German Engineers' Society in 1927, to meet need for handbook of theory and practice; present sheets, arranged to be inserted in original loose-leaf book, contain accounts of new investigations; in these nine supplements are investigations of ductility and resistance to internal pressure of metals, mechanical structures of brass, behavior of zinc-copper alloys at high temperatures, amalgams, cobalt, and platinum metals. Eng. Soc. Lib., N. Y.—E.I.S., New York.

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Lead Refining: Electrolytic—The Betts Electrolytic Lead Refining Process in Practice. J. J. Fingland. *Am. Electrochem. Soc.*, No. 57-10, May 29-31, 1930.

TRAIL electrolytic lead plant is pioneer Bett's plant; cells, arranged in multiple and cascade, are made of concrete and lined with asphaltum; general layout of cell room is similar to that of copper refinery at Great Falls; for circulation of electrolyte, plunger and centrifugal pumps constructed of copper with Monel metal wearing parts are used; details as to equipment and operation are given.—E.I.S., New York.

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Mine Shafts: Heating—Heating Shafts to Cope With Frost. *Colliery Guardian*, Vol. 140, No. 3619, May 9, 1930.

DATA from summary of answers to questionnaire sent to members of Essen Mining Society, in connection with trouble experienced in Ruhr coal field during winter of 1928-1929, due to formation of ice in mine shafts; 50 per cent of coal mines found open or closed coke fires satisfactory; Oplaender type of air heating plant is illustrated. Abstract translated from Glueckauf, no date.—E.I.S., New York.

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Zinc Ore Treatment: Electrolytic—The Electrolytic Zinc Plant. U. C. Tainton and D. Bosqui. *Am. Electrochem. Soc.*, No. 57-27, May 29-31, 1930.

ELECTROLYTIC zinc produced is 99.99 per cent pure; daily capacity of plant at Evans-Wallower Company at East St. Louis, Ill.; notes on drying and roasting of concentrates; leaching; purification department; cadmium plant; electrolytic division; curves and tables are given.—E.I.S., New York.

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Grinding Mills: Silica — Modernized Silica Grinding Pays Big Dividends. R. L. Cawood. *Chem. and Met. Eng.*, Vol. 37, No. 5, May, 1930.

DUE to reconstruction of grinding plant of Potters Mining & Milling Company at East Liverpool, Ohio, cost of grinding has been cut almost in half, while quality of product has been greatly improved; new grinding unit replaces half of batch-type mill, and replacement of balance will be undertaken at early date; it consists of Patterson 8x10-ft. continuous feed-and-discharge ball mill, lined with silex and operated in conjunction with 14-ft. air separator.—E.I.S., New York.

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Copper Smelting — Blast Furnace vs. Reverberatory. W. C. Davis. *Canadian Min. Jl.*, Vol. 51, No. 18, May 2, 1930.

DISCUSSION of relative merits of three current smelting methods and suggestion as to future practice, with particular reference to copper-nickel ores of Sudbury district; review of advantages and disadvantages of each type of furnace; advances in reverberatory practice; value of sintering; converter for smelting; flotation may induce new smelting methods.—E.I.S., New York.

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Copper Refining: Electrolytic — The Series System of Electrolytic Copper Refining at Nichols Copper Company. F. R. Gorwin and C. S. Harloe. *Am. Electrochem. Soc.*, May 29-31, 1930.

DURING recent years, Nichols Series System of electrolytic refining has been developed so that improvements made together with its inherent qualifications have placed it in strong competitive position with multiple system as to quality of production, grade of material handled, cost of production; tie-up of metals in process, and precious metal loss to cathode.—E.I.S., New York.

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Hydrometallurgy — Status of Electrolysis as a Metallurgical Process. T. H. Donahue. *Am. Electrochem. Soc.*, No. 57-20, May 29-31, 1930.

BRIEF review of status of copper, zinc, lead, cadmium, silver, bismuth, and nickel; difficulties of present electrolytic processes are examined; importance of precious metal byproducts is emphasized; improvements in process and possible introduction of new methods are discussed; many novel industrial applications of electrolytic methods to above and to other metals are suggested.—E.I.S., New York.

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Manganese Ore Treatment: Magnetic—The Magnetic Concentration of Certain Natural and Artificial Manganese Dioxides. T. J. Martin. *Am. Electrochem. Soc.*, No. 57-24, May 29-31, 1930.

RESULTS of magnetic concentration test on number of manganese dioxides, which are weakly magnetic; extractions are made at various magnetic intensities, on material ground to several degrees of fineness; data show that it is possible to remove highly magnetic impurities from ores, but it is not possible to separate weakly magnetic impurities from all manganese ores efficiently with flux densities used.—E.I.S., New York.

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Mines and Mining: Scraper Loading—Uses and Differences in Design of Drag-line Scrapers in the United States and Germany. W. Franke. *Foerdertechnik und Frachtverkehr*, Vol. 23, Nos. 8 and 9, April 11 and 25, 1930.

INTRODUCTION of drag-line scrapers in Germany; American types; in Germany scraper loading has been found most useful in potash mines, and in coal-mine storage. Cost of operation of installation by Maschinenfabrik Hasenclever A-G in Germany; advantages and disadvantages compared to old system.—E.I.S., New York.

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Sand—Basic Industrial Minerals: The Sands. G. M. Dyson. *Chem. Age*, Vol. 22, No. 569, May 24, 1930.

CLASSIFICATION as to constructional, metallurgical, chemical, and abrasive sands; chemical and physical properties; porosity and permeability.—E.I.S., New York.

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Copper Smelting—The Form of Copper in Converter Slag. F. S. Wartman and W. T. Boyer. *Metal Industry*, Vol. 36, No. 21, May 23, 1930.

VARIOUS synthetic products used in solution tests were as follows: copper powder, matte, cupric, silicates 1, 2, and 3, copper ferrite, reverberatory slag, oxidized slag and sulphide slag; results of tests; conclusions. (Concluded.)—E.I.S., New York.

PATENTS

Mine Car. No. 1,769,939. July 8, 1930. A. Berasi, Freeport, Pa.

Design for a mine car.

Car Dumper. No. 1,770,275. July 8, 1930. E. H. Kidder, asignor to Link-Belt Company, Chicago, Ill.

Design for a rotary car dumper.

Ore Concentrator. No. 1,762,265. June 10, 1930. R. C. Fehely and R. F. Stevenson, Keno, Ore.

Design for a wet magnetic concentrator.

Rock Drill. No. 1,766,578. June 24, 1930. W. T. Wood, assignor to Byron Jackson Company, San Francisco, Calif.

Design for a rock drill.

Car Dumper. No. 1,768,847-49. July 1, 1930. E. H. Kidder, assignor to Link-Belt Company, Chicago, Ill.

Design for a car dumper.

Rock Drills. No. 1,758,492. May 13, 1930. L. C. Bayles, assignor to Ingersoll-Rand Company, Jersey City, N. J.

Blowing device for rock drills.

Drill Steel. No. 1,769,921. July 8, 1930. C. C. Hansen, assignor to Ingersoll-Rand Company, Jersey City, N. J.

Design for a centralizer for drill steels.

Mine Car. No. 1,762,667. June 10, 1930. H. W. Sanford and P. S. McCallen, assignors to Sanford Investment Company, Wilmington, Del.

Design for a mine car.

Disk Drill. No. 1,769,371. July 1, 1930. W. S. Holdaway, assignor to Byron Jackson Company, West Berkeley, Calif.

Design for a rotary disk drill.

Rock Drills. No. 1,756,466. April 29, 1930. A. R. Mack, assignor to Ingersoll-Rand Company, Jersey City, N. J.

Design for valve on a rock drill.

Metallurgical Furnace. No. 1,766,110. June 24, 1930. D. Cushing, Cambridge, Mass.

Design for a cupola furnace, operating with compressed air or natural draft.

Ore Reduction. No. 1,764,511. June 17, 1930. T. R. Haglund, Stockholm, Sweden.

An electric furnace for reducing metal oxides.

Holder for Miner's Lamp. No. 1,768,196. June 24, 1930. Eli Israel, Wilkes-Barre, Pa.

A lamp-supporting attachment for a miner's cap.

Portable Drill Mounting. No. 1,758,-316. May 13, 1930. C. H. Hansen, assignor to Ingersoll-Rand Company, Jersey City, N. J.

Design for a portable rock-drill frame.

Removing Dust From Electrodes. No. 1,758,404. May 13, 1930. A. L. Labbe, assignor to American Smelting & Refining, New York, N. Y.

An apparatus for removing dust from the electrodes in an electric precipitator.

Non-tarnishable Silver. No. 1,758,293. May 13, 1930. W. S. Murray, assignor to Oneida Community Limited, Oneida, N. Y.

Process of treating silver to render it tarnish resisting, consisting in subjecting the silver to the action of a halogen element.

Roasting Fines. No. 1,758,188. May 13, 1930. H. J. Cordy & W. J. Burgoyne, assignors to General Chemical Company, New York, N. Y.

Process of roasting finely divided sulphide ore by suspension in an oxidizing gas.

Lead-Silver Anode. No. 1,759,493. May 20, 1930. U. C. Tainton, East St. Louis, Ill.

Anode for use in the electrolysis of zinc and manganese salts, consisting of an alloy containing lead and silver.

Flotation. No. 1,765,308. June 17, 1930. G. Lutz, assignor to Grasselli Chemical Company, Cleveland, Ohio.

A froth-flotation process involving the use of an alkyl-naphthalent sulphonic-acid compound.

Roasting Furnace. No. 1,758,154. May 13, 1930. J. Harris, Sheffield, England.

Design for a mechanical, multiple-hearth roasting furnace.

Copper Refining. No. 1,769,986. July 8, 1930. M. G. Corson, Jackson Heights, N. Y.

Process for degasifying and deoxidizing copper by treatment at a pressure below atmospheric pressure.

Metallurgical Process. No. 1,769,604-05. July 1, 1930. R. D. Pike, Piedmont, Calif.

Process of treating copper-bearing iron ores by chloridizing, recovering the iron by electrolysis of the chloride solution.

Bessemer Converter. No. 1,768,649. July 1, 1930. E. I. Williams, Copperhill, Tenn.

Bessemer converter with two set of tuyères, operated alternately in order to preserve the lining.

Roasting Process. No. 1,769,405. July 1, 1930. F. L. Wilder, E. Morris, E. Schiff, and E. S. King, assignors to Electro-Metallurgical Ore Reduction. London, England.

Process for roasting tin-bearing materials.

Sintering Machine. No. 1,764,695-6. June 17, 1930. E. W. Shallock, assignor to American Ore Reclamation Company, Chicago, Ill.

Design for a sintering machine consisting of a train of pallets on an endless track.

Treating Auriferous Ores. No. 1,766,767. June 24, 1930. C. L. Votaw and C. A. Andrews, Bakersfield, Calif.

Treatment of refractory auriferous ores by grinding the ores with a solution containing a cyanide, a hydroxide of the alkali metals, and sodium carbonate, drying the pulp without removing the solution and smelting the dried pulp.

Deoxidizing Copper. No. 1,755,309. April 22, 1930. C. S. Smith, assignor one-half to C. R. Hayward, Cambridge, Mass.

A method of deoxidizing copper consisting of reducing the copper chemically at a temperature below the melting point.

Manganese Ores. No. 1,768,112. June 24, 1930. J. H. Brennan, assignor to Electrometallurgical Company.

Treatment of ores containing manganese dioxide and iron with a silicon to obtain a manganese-iron slag higher in manganese than the original ore.

Electrolytic Cell. No. 1,755,380. April 22, 1930. E. O. Barstow, assignor to Dow Chemical Company, Midland, Mich.

A cell for electrolyzing fused salts of the lighter metals.

Recovery of Volatilizable Metals. No. 1,755,712. April 22, 1930. H. Stephani, assignor to F. Krupp, Magdeburg, Buckau, Germany.

A continuous process for recovering volatilizable metals from ores, residues, and similar products.

Treatment of Arsenious Ore. No. 1,763,435. June 10, 1930. A. R. Lindblad, Djursholm, Sweden.

Treatment of arsenious ores by roasting in the presence of substances forming insoluble arsenates, and smelting the resulting product to remove these substances in the slag.

Flotation. No. 1,762,364. June 10, 1930. E. H. Snyder and W. D. Green, assignors to Combined Metals Reduction Company, Stockton, Utah.

Flotation of lead, silver, and copper minerals by conditioning the ore with sodium chloride and a sulphidizing agent preparatory to froth flotation.

Roasting Process. No. 1,749,125 March 4, 1930. F. A. Brinker, San Francisco, Calif.

A two-step sulphatizing roast, in the second step of which the minerals from the first step move concurrently with the gases from the first step and are sulphatized.

Copper Metallurgy. No. 1,759,078. May 20, 1930. A. D. Wilkinson, assignor to Cananea Consolidated Copper, Cananea, Mexico.

Method for feeding reverberatory furnaces, consisting of using a moist feed, which is disposed at an abnormally steep angle so as to allow a molten bath of abnormal width.

Zinc Dust. No. 1,762,716. June 10. 1930. H. A. Grine, assignor to Grasselli Chemical Company, Cleveland, Ohio.

Process for production of zinc dust consisting of volatilizing the zinc in a closed chamber, passing the zinc vapors through a restricted opening and condensing the vapor by cooling under a pressure lower than that obtained in the chamber.

Mercury. No. 1,762,861. June 10, 1930. W. Glaeser, assignor to Glaeser Research Corporation, New York, N. Y.

Production of mercury from cinnabar ore by reducing the finely divided ore in the presence of water and a metal capable of forming an amalgam with the mercury.

COMMENT AND CRITICISM

California's Internal Troubles

To the Editor of "E.&M.J.":

An Information Circular, U. S. Bureau of Mines, May, 1930, on mine safety and accident economy in Colorado metal mines, states:

"The state metal-mining accident experience has been discussed with state officials administering the Colorado Workmen's Compensation Act and it appears that on a basis of a rate of about $4.27 per $100 of pay roll the state metal-mining accident experience has been such that during the past six months an insurance dividend of 25 per cent was possible. However, the accident fatality rate of Colorado metal mines is high compared with the United States average and the cost to operator and miner is a large sum even in comparison with the value of the mineral output of the state. Lessening of accidents should materially decrease the insurance rate."

The California basic rate for mines is $9.42, whereas Colorado is only $4.27, yet Colorado can pay a 25 per cent dividend, which makes the cost $3.20.

California has the highest payments for injuries to employees of any of the states, because of the liberal provision of the Workmen's Compensation Act. This fact does not encourage industries; it is most injurious. No reason exists why California should be more liberal than any other state in this matter. All industries should realize this condition and assist in securing amendments to the California act which will remedy this condition.

For the year 1927-1928, California was second in the list of states with a per-capita tax burden of $78.16. This was for state, county, and municipalities. As a result of the adoption of the State Corporate Franchise Tax Act, no doubt the burden will be increased, and it is possible that California will be first as to taxes.

Among the total expenditures of the State of California, education received 37.8c. out of each dollar for the fiscal year ended June 30, 1926; this amounted to 36.56 per cent, or $29,754,618. For the year ended June 30, 1928, education received $34,609,379, public works $21,547,545, regulative $10,476,519, and Veterans' Welfare Board, $12,177,072. These were the largest expenditures. The total amount collected for that year was $178,490,253. There was a balance on hand of $48,552,385 at the end of that fiscal year.

The Corporate Franchise Tax Act of California, passed by the last legislature, increases the cost on industries which cannot afford to pay this tax and reduces taxes for industries which are in a flourishing condition. Mining is one of the industries which is not in a prosperous condition, and it now pays both a state and federal tax on profits. It was difficult enough to pay the federal tax, but now the state demands a part of the profits. Gold mining, especially, should be encouraged to produce rather than be penalized for adding to the supply of the world's wealth.

Let us consider the taxes which must be paid by a mine in California—county, and also city if within a municipality, state, and federal, if any profit is made. The county taxes for mines are excessive, and it appears to be the tendency on the part of assessors to have such property carry the greater part of the tax burden. In one county, with only three operating mines of any magnitude, the mines pay 25 per cent of the taxes. In this county, the public schools receive 80 per cent of the money collected in taxes. In another county, two mines paid 80 per cent of the taxes for a long period of years. When operations were curtailed at these two properties, the expenditures for public schools were immediately reduced without doing any apparent harm to educational facilities.

It is obvious that whenever large sums are available for any governmental body, care is not exercised in expenditures. Certainly, this seems to be the condition in California.

In order to attract industries to this state, adequate inducements such as reasonable taxes must be offered.

G. Chester Brown,
Secretary, California Metal and Mineral Producers' Association.

San Francisco.

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Close-Up of a Rock Burst in a Butte Mine

To the Editor of "E.&M.J.":

While engaged in driving or advancing the "sill" on the 3,200-ft. level of a large mine at Butte, Mont., I had an opportunity to observe a violent rock burst. Details of the burst follow. Stoping operations were considerably behind the sill work. Average dimensions of the working breast were 9x20 ft., and timber was kept 10 to 15 ft. behind the working face.

At irregular intervals the ore in the breast gave off sharp, crackling and snapping noises, accompanied by the breaking loose of small fragments of the ore with sufficient violence to hurl fragments a distance of ten feet. The smaller fragments flew almost in the faces of miners, causing some pain and considerable mental anxiety.

Danger was most in evidence in the back or roof of the workings. Here the snapping and popping were accompanied by flashes of fire and the broadcasting of considerably larger pieces, suggestive of shrapnel. This served as an excellent warning that an extensive slab was in the making. Upon testing with a pinch-bar, slabs almost as large as the opening outside of the timber and from 4 in. to a foot thick were brought down.

These phenomena did not occur throughout the ledge, because the friability of the ore gradually diminished. The ore matrix in which the aforesaid phenomena were observed was a hard, brittle, homogeneous mass.

The reactions in the back or roof led me to believe that the burst was a "strain" burst caused by the application of dynamic pressure to a firm and brittle ore mass that would not show strain by deflection or distortion but would fail suddenly with a cracking report. The flashes of fire that accompanied the burst were probably due to the collision of sulphide ore particles.

The bursts in the breast, however, are not so easily explained. The theory that these might have been caused by static pressure does not seem applicable. Perhaps the real cause may have been the release of static pressure caused by subsidence.

C. M. Harrer

Butte, Mont.

New Publications

GOLDEN DAYS *(Memoirs and Reminiscences of the Gold Fields of Western Australia). By Jules Reside (W. J. Reaside). Pp. 415; illus. Perth, Western Australia: Colortype Press. Price not stated, but probably $2.50.*

THE State of Western Australia recently celebrated its centenary as a colony and state and the half century since the discovery of gold therein. This semi-biography and collection of narratives and anecdotes covers a period of 37 years, during which the author was somewhat prominent as a prospector and as an observer of events. To the reviewer, and to those who are no longer in W. A., as the state is termed (and there are a fair number in America), this recounting of experiences revives the memory of many events and names, while the pictures remind one of many scenes "out-back."

Discovery of gold at Southern Cross in 1888 by Anstey, Colreavy, and others; at Coolgardie, in 1892, by Bayley and Ford; at Kalgoorlie, in 1893, by Hannan, Flannigan, and Shea; later at Kanowna, by McAuliffe; at Menzies by Menzies; at Cue, by Cue; and at Leonora, by Sullivan—these are milestones in the history of a country that has yielded $810,000,000 in gold and distributed $140,000,000 in dividends. The author includes a pioneer's gallery of 70 men, many of whom are in indigent circumstances.

The fires at Coolgardie (correctly Coolgabbie, or "cool water"); the cemetery rush and the hoax of Father Long's "Sacred Nugget," at Kanowna; the Ivanhoe Venture alluvial trouble; the McCann bogus rush out from Coolgardie; the Bonnivale mine flood, in which a man was entombed nine days in an air pocket and rescued by a diver; and the dissatisfaction of the gold fields over the then Colonial Parliament's attitude toward the proposed federation of all Australia, are some high spots of the gold fields. F. C. B. Vosper was an ardent advocate of federation.

Among former gold-fields men who have risen to prominence in the world, the author gives considerable space to Herbert Hoover, President of the United States, who first arrived in W. A. in 1896 and remained until 1898, and revisited the mines in 1905 and 1907. His ability and skill are highly regarded out there. Other men from the region who have risen to political heights include Philip Collier, to present Premier of the state; Charles Fraser and Hugh Mahon, to Federal Postmaster General; J. M. Hopkins, J. W. Kirwan (an editor), C. J. Moran, A. E. Morgans, Wallace Nelson (a wit and humorist), John Reaside (the author's brother), and John Scaddon, (Premier in 1911-16), to the State Parliament.

Additional well-known men who are pictured and noted are Canon Collick, an indefatigable Church worker among all denominations; E. G. Murphy ("Dryblower"), a pioneer and bard of the gold fields, a prolific writer of poetry; Ben Strange, a cartoonist; John (Jack) Sutherland, former general manager of the Horseshoe mine; Richard (Dick) Hamilton, former general manager of the Great Boulder; and Sir John (later Lord) Forrest, who said in Parliament, "I shall cause a river of pure water to flow through the land," which prophecy was consummated in 1902 through the engineering ability of C. Y. O'Connor. Water flowed to Kalgoorlie a distance of 353 miles through 30-in. pipe at the rate of five million gallons a day. I remember that hot day in February, 1902, when the water, after its journey of more than ten days, reached the reservoir at Kalgoorlie.

The rambling nature of "Golden Days" is excusable because it covers so many periods, events, and people. Interspersed is short verse by the author, and at the end are 40 pages of poems by him, by "Dryblower," and others. Prospecting methods, and the hazards of two prospecting expeditions, in one of which the author's party was saved from death from thirst by aborigines; habits of the aborigines or blacks (not "bushmen" as incorrectly termed in America); and a description of the first wedding in Coolgardie in which "Smiler" Hales reviewed humorously, in well-known mining terms, the dresses worn, are among odds and ends found in this book. A good index has been prepared, and also an errata sheet, but there are other minor slips here and there. As a whole, a readable and authoritative chronicle.

M. W. VON BERNEWITZ.

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A NEW DEVELOPMENT IN THE PREPARATION OF BRIQUETTED MINERAL GRAINS. *By R. E. Head, microscopist, U. S. Bureau of Mines, and Morris Slavin, microscopist, United Verde Copper Company. University of Utah, Salt Lake City. Price, 15c.*

THE constantly increasing tonnage of low-grade ores being treated by flotation emphasizes the need for a detailed and thorough understanding of the characteristics of these ores and a better working knowledge of the facts underlying modern plant operations. Any method that increases the general store of knowledge of these processes makes possible the more intelligent application of effort in the solution of the problems encountered in complex ore treatment. Inasmuch as the chemical methods employed in the plant assay offices are limited in their application to problems involving certain physical characteristics of ores and minerals, operators have adopted the microscope to supply the deficiency.

Since the needs of the situation require the study of mineral grains of very small size, there has developed a technique quite different from that usually employed in the preparation of mineral specimens for microscopic study. The minute size of the particles makes it impossible to handle them individually, and the study of unmounted grains spread on the stage of the binocular miscroscope is unsatisfactory for the determination of middling grains and inclusions. Obviously, some form of mount must be used.

The new development in briquetting of finely divided mineral grains is described in this paper, and directions are given for the construction of an efficient, inexpensive press. These interesting data should be of great value to mills, schools, and colleges where microscopic studies of metallurgical problems are carried on.

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MICA. *By H. S. Spence. Pp. 142, with two maps in colors and one chart. Mines Branch, Department of Mines, Ottawa, Ont. Price 30c.*

ABRASIVES. *Part 4, Artificial Abrasives, and Manufactured Abrasive Products and Their Uses. By V. L. Eardley-Wilmot. Mines Branch, Department of Mines, Ottawa, Ont. Pp. 144. Price 20c.*

THE Canadian Department of Mines, and Mr. Spence and Mr. Eardley-Wilmot, are again responsible for two excellent bulletins on the mineral resources of Canada. Not only is there much detailed information concerning Canadian occurrences and markets, but the production from other parts of the world is considered as well, so that any producer or consumer of the mineral that is discussed could find much valuable information therein contained regardless of his geographical location.

Mica is supplied chiefly by India, the United States, Madagascar, and Canada. India and the United States produce muscovite exclusively, whereas Canada's output is practically all amber mica, or phlogopite. Mr. Spence takes up in order the world's supply and production; the distribution, mode of occurrence, method of mining, and preparation for market of Canadian mica; marketing of mica; uses and manufacture; and

patents relating to mica manufacture and uses. The text is well illustrated with halftones on special paper.

Mr. Eardley-Wilmot has divided the subject of abrasives into four parts, the first three of which were issued two or three years ago, and has perhaps given a somewhat greater amount of space to occurrences and conditions outside of Canada than did Mr. Spence on mica. Part 1 covered the siliceous abrasives such as sandstone, quartz, tripoli, pumice, and volcanic dust. Part 2 was on corundum and emery, with a page or two on the diamond, and Part 3 was entirely devoted to garnet. The recently issued Part 4 is on the subject of artificial abrasives, and manufactured abrasives and their uses. A fairly complete bibliography is included in each of the sections.

The Mines Branch has also just issued the fifteenth edition of its catalog of publications, which will be sent free on request. Other recent bulletins on mineral resources include one by L. Heber Cole on silica, and one by Mr. Eardley-Wilmot on diatomite. Mr. Cole also has one on gypsum and one on salt in preparation.

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JOHANNESBURG (OUT OF THE CRUCIBLE). *By Hedley A. Chilvers. New York: Frederick A. Stokes Company. Pp. 274; illustrated. Price, $3.50.*

AN ESTIMATE of the richness or vividness that the history of any particular country may be said to possess is largely a matter of personal opinion based on travel, business endeavor, or national affiliations. If this premise be admitted, the interest that many members of the mining profession have in the history of South Africa is readily understood, particularly so when it is borne in mind that mining men have made more history there than in any other section of the world. Moreover, those who have either visited or been engaged professionally in the country experience a satisfying reaction in knowing that their colleagues have been so outstandingly influential in the country's growth and rise to its present position. That South Africa and its history have a fascination for the mining fraternity is therefore but natural.

Inasmuch as the major portion of the historical background of South Africa centers about Johannesburg, Mr. Chilvers' book covers to a large extent the development of the entire country. The volume will be read with much interest by many mining men, for the author seems to have captured and recorded those elements of South African history that comprise the aforesaid fascination. Although the work is not a formal history, a diligent searching on the part of the author for new material, and painstaking inquiry into the veracity of various statements already published, evident throughout the volume, give it historical significance. These characteristics are strikingly apparent in chapter two, in which credit for the discovery of the Witwatersrand gold deposits is given to Fred Struben. In the concluding section of this chapter, Mr. Chilvers writes:

"For many years there has been discussion as to who was the real discoverer of the Witwatersrand gold fields—discussion which has sometimes become somewhat acrimonious.

"An impartial examination of the facts presented in this chapter, however, ought to prove that the honor of discovering the Witwatersrand rests preeminently with Fred Struben, who, in June, 1929, was still living at Spitchwick Manor, Ashburton, Devonshire. Ever the most modest of men, he has always refrained from making claims. Other names, such as those of Harry Struben, Arnold, Bantjes, Nourse, and Robinson, have been put before his and championed by ardent (and often ignorant) supporters. . . .

"The truth is that in 1883, Fred Struben recognized, as in a flash of genius, the vast potentialities of the Witwatersrand gold reefs. . . .

"George Walker, it is true, chanced upon a rich portion of the main reef leader, but it had been previously tapped elsewhere in a poorer section by Struben. Walker's was a rich find, and every credit is due him for making it; but Struben had preceded him. To him, alone, therefore, belongs the honor of having 'discovered' the Witwatersrand."

Numerous references, including many quoted utterances, are made to Cecil Rhodes, Barney Barnato, John Hays Hammond, and others prominent in the mining and political development of the Rand and South Africa. This material, together with well-told anecdotes, sustains the reader's interest. Prize fighting on the Rand, with a graphic account of the Couper-Bendoff fight in 1899; the establishment of the first churches and theaters; how Chinese coolie labor and the cyanide process each saved the life of the gold-mining industry in two different periods—these developments, as well as the Anglo-Boer War and labor disturbances on the Rand, are all described in what appears to be a faithful and unprejudiced manner.

As to the future of the Witwatersrand, Mr. Chilvers writes: "Will the gold reef last; and the big city and the hiving population that have grown up around it—will these also endure? Or can it be that the Reef is approaching exhaustion, and that all its correlative interests are doomed to extinction?

"The answer, however, is a very hopeful one, and it is based on the belief, which has now been established as a fact, that the Reef persists far below any point yet reached by the miners of the Witwatersrand. Given certain conditions, among which are (1) continued progress in engineering technique as applied to economical deep-level mining, and (2) sympathetic enactments by future governments intrusted with mining taxation, the Reef will be worked profitably a hundred years from now."

In the preface of his book, Mr. Chilvers says that the compilation of the volume was an absorbing task that he completed with regret; that, considering the wealth of dramatic material at the disposal of writers, it is surprising that such a compilation has not been essayed before. To all of which many members of the mining industry will heartily agree, at the same time acknowledging a debt of gratitude to the author for his initiative. H. D. KEISER.

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THE ALUMINUM INDUSTRY. *By Junius D. Edwards, Francis C. Frary, and Zay Jeffries. New York: McGraw-Hill Book Company, Inc. Vol. 1, pp. 358, Vol. 2, pp. 870; illustrated. Price $12.*

THIS is a comprehensive book. The authors, on the staff of the Aluminum Company of America, have had at their disposal the accumulated knowledge of this large organization, as well as the valuable advice of their associates. The aluminum industry is a comparatively recent development. To obtain a correct perspective is more difficult than in most other branches of metallurgy, and good judgment is essential in weighing the importance of its many phases. This problem the authors have handled successfully.

The subject is discussed in two volumes, the first of which, bearing the subtitle "Aluminum and Its Production," covers the history and discovery of the metal, with a general description of the ores and the common mining processes. Refining of the ore and manufacture of alumina are treated in detail, with a thorough discussion of the numerous patents, most of which are of academic interest only. The final chapters, devoted to electrolysis, contain details of the electrical equipment used and of the manufacture of electrodes and furnace lining.

The second volume bears the subtitle "Aluminum Products and Their Fabrication." Methods of fabrication, such as rolling, drawing, and extrusion, are discussed in a broad manner, to give the reader a general knowledge of these processes, of particular interest only to a few manufacturers. Casting, machining, and other fabrication processes, however, of more direct interest to users of aluminum, have been treated in greater detail. Much space is devoted to the numerous alloys of aluminum, their application and physical characteristics. The wide application of aluminum in its varied forms and its increasing usefulness to modern industry are discussed at length.

Both volumes have numerous illustrations and contain complete bibliographies. They should be a valuable addition to every technical library.

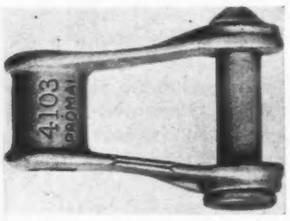
INDUSTRIAL PROGRESS

Some New Ideas in Conveying Equipment

—Blast Furnace Blowers of Record Size

—Novel Ball Bearing Patented

FOR three years the Link-Belt Company, Chicago, Ill., has been experimenting quietly with a new cast metal, known as Promal, for conveyor and drive chains. Chains made of it are said to show unusual strength and durability in comparison with malleable chains. Its physical characteristics are so different, the manufacturers say, that it may be regarded as a new metal.



Conveyor link of new improved cast metal

Compared with malleable iron, the new material has an average yield point of 45,000 lb., against 36,000; an average ultimate strength of 65,000 lb., against 54,000; an average elongation of 14 per cent, against 18; and a Brinell hardness of 170-190, against 110-130. Compared with mild cast steel, annealed, it has an average yield point of 45,000 lb., against 34,000; an average ultimate strength of 65,000 lb., against 60,000 lb., an average elongation of 14 per cent, against 26; and a Brinell hardness of 170-190, against 120-140. It therefore has great toughness, high strength in proportion to weight and size, and hardness—all desirable qualities in sprocket chain material. High temperature reduces its tensile properties somewhat, but it does not become brittle at any point up to 1,000 deg. F.

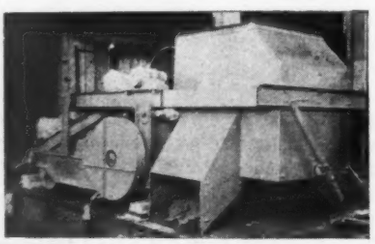
In performance tests, one chain of this material, installed in a cement mill, where the air is saturated with dust, has already lasted more than twice as long as the malleable chain previously used. In another plant, one of the chains driving a tumbling barrel on a short-center drive with a jerky load has lasted six times as long as the malleable chain replaced, and is still in operation. Chains of the new metal are recommended for the following kinds of service: chain drives, elevators and conveyors operating under gritty or abrasive conditions; chain drives where greater strength is needed than the corresponding size of malleable chain provides; drag, scraper, and flight conveyors where the chain is subject to abrasion; and heavy-duty drives of comparatively high speed, short centers, and large sprocket ratios.

Large Blast Furnace Blowers

The Tata Iron & Steel Company, Ltd., Jamshedpur, India, has recently ordered from the Escher Wyss Company, Zurich, Switzerland, two large steam-turbine-driven turbo blowers for the company's new blast furnaces. Each is capable of delivering 130,000 cu.ft. of free air per minute against 27-lb. gage. The air is preheated. Turbine capacity is 13,700 hp. each. These blowers must run under widely varying load and speed and must remain under the control of an automatic air-volume regulator. The blowers will be the largest built for the purpose. Each will blow a single stack having a capacity of approximately 1,600 tons of pig iron per day. National Power Machinery Corporation, New York, is agent for the Swiss manufacturers.

Unique Conveyor Tripper Spout Discharges Two Ways

The two-way discharge spout on the belt conveyor tripper illustrated is built to stand heavy punishment. It is made of ¼-in. steel plate and is lined with manganese-steel liners and provided with a stone box to reduce the shock and wear caused by large pieces of ore discharged from the belt. The stone box consists of a shelf on which the material piles until it has reached the angle of repose. This cushions the impact and saves wear at the point where it is usually greatest. The so-called flop gate lever shown can be shifted to deflect the discharge to either side.



Novel conveyor tripper spout

This spout and tripper were built by the Stephens-Adamson Manufacturing Company, Aurora, Ill., for an Arizona mill. It serves a 42-in. conveyor and has a capacity of more than 700 tons per hour. The tripper itself is 14 ft. long by 9 ft. wide, and weighs 14,000 lb. Heavy-duty axle journals and the pulley-shaft bearings are equipped with Hyatt roller bearings. All tripper bearings are provided with pressure fittings. The tripper may be driven in either direction at 62 ft. per minute by a 10-hp. motor. A revolving brush keeps the belt clean.

A Felt-Seal Ball Bearing

A new type of patented felt-seal ball bearing having certain distinctive features has been developed by SKF Industries, Inc., New York. A felt seal is provided as an integral part, making it necessary for the machine manufacturer to provide only one housing enclosure. The outer and inner races as well as the balls are made of high-carbon, chrome-alloy steel hardened throughout. Bore and outside diameter are ground to international standard dimensions and tolerances, as in the corresponding standard single-row bearings. The width, however, is slightly greater than the standard dimension of a single row bearing, to accommodate the felt seal. All tolerances on eccentricity of the outer and inner races are also international standard tolerances for single-row ball bearings. In this bearing, the inner race projects a little beyond the face of the seal, so that the bearing may be pulled off the shaft at any time without damaging the seal plates.

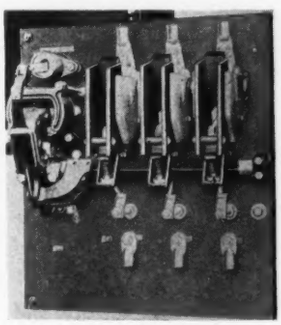
A felt seal is an integral part of this bearing

The seal consists of an inner steel plate dished at its periphery and bearing against a shoulder formed on the outer race. A removable felt of substantial

size comes next, then a dished steel end plate, after which a split steel ring is fitted into a groove in the outer race to hold the assembly in place. A feature of the bearing is the ease with which the seal may be disassembled at any time and new felts applied. To disassemble it, the split steel ring is sprung out of the groove in the outer race, after which all the other component parts of the seal may be readily lifted out. The bearing is available in sizes applicable to a wide range of small mechanical equipment.

New Contactors for Heavy A.C. Duty

Two magnetic contactors for heavy-duty a.c. service have been introduced by Cutler-Hammer, Inc., Milwaukee, Wis. They are rated for maximum capacities of 300 to 600 amp. respectively. The former size is illustrated. They are arranged for either two- or three-wire control, have continuous-duty operating coils, efficient magnet structure, and heavy butt-type solid-copper contacts. Shock on closing is absorbed by an air cushion, reducing wear and insuring quiet operation. The 300-amp. size is mounted in a wall-type inclosure, and the large one in a floor-type case.



Magnetic contactors for heavy-duty a.-c. service

Pressure Lubrication

A lubricant compressor which makes possible the delivery of lubricant under tremendous pressure throughout an entire plant has been developed by the Alemite Corporation, 2650 North Crawford Ave., Chicago, Ill. It is operated on standard air pressures, automatically controlled from remote outlets, and is known as Model Pa-400. It is shown in the accompanying sketch. The compressor stands about 6 ft. high and has a capacity of 400 lb. of lubricant, being able to receive the entire contents of a drum at one time. At the bottom of the main cylinder is a floating ram or plunger, on top of which the lubricant is poured in loading the compressor. Air under pressure is spread into the main cylinder beneath the ram, which forces the lubricant supply upward, priming the high-pressure cylinder and supplying it with lubricant. The action is sufficient to feed the very heaviest lubricant to the high-pressure pump.

Hung on the side of the compressor is an independently air-operated motor, the piston of which is directly connected to the piston in the high pressure or booster cylinder. Although the air motor itself is double-acting, the booster or high-pressure piston builds up pressure in the outlet line only when forced upward. The compressor is unique in that the air motor operates only when a release valve at some remote point in the outlet line is opened, releasing lubricant under pressure. Lubricant can be delivered under pressures as high as 5,000 lb. per square inch and the device can deliver a maximum of 20 lb. of lubricant per minute. The main line pipes leading from the compressor are either $1\frac{1}{4}$ or $1\frac{1}{2}$ in. in diameter. For smaller leads 1-in. pipes are used.

The company has also developed another compressor of smaller capacity, the Model Pa-100.

A Rotary Drilling Engine

A 12x12-in. twin roller-bearing rotary drilling engine to operate at 350-lb. steam pressure has been introduced by Gardner-Denver Company, Denver, Colo. It is Model DEB and is 9 ft. $\frac{1}{2}$ in. long and 6 ft. 5 in. wide. Height of the engine proper is 3 ft. $11\frac{5}{8}$ in., and the over-all height 4 ft. $7\frac{3}{4}$ in. Total weight installed is 14,000 lb. All moving parts are inclosed and lubricated by a splash system. They are counterbalanced, the reciprocating part being as light as possible. This permits the inertia of the system to be reduced to a point allowing rapid acceleration either from rest or when the drive is reversed.

An Anti-friction Pillow Block

Improvement of its Timken anti-friction ball-and-socket pillow block has been announced by the Link-Belt Company, Chicago. This block is designed to fit any good grade of commercial shafting from $1\frac{7}{16}$ in. diameter to the largest, without special fittings or other appliances. Pressure fittings are provided for lubrication.

Mill sampler electrically operated through speed reducer

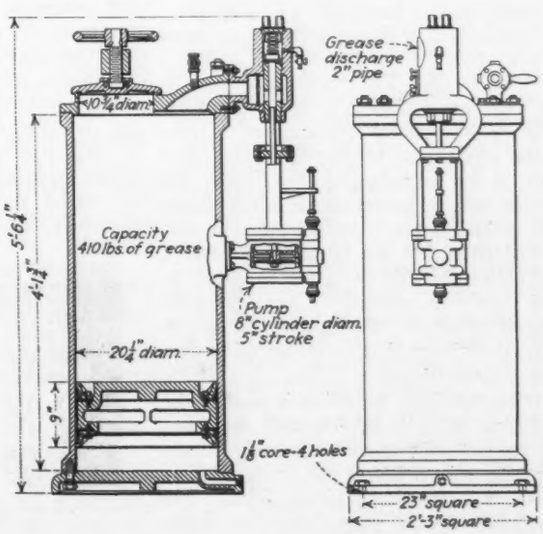
For Mill Sampling

A new electrically operated Scobey sampler has been introduced by Mine & Smelter Supply Company, Denver, Colo. It is direct-motor-driven through a speed reducer and is timed to take a sample every eight minutes. One sampler is usually placed at the head of a mill to take a dry sample up to $\frac{3}{4}$ in. in size. A second sampler is used on the tailing. To obtain complete data for calculating extraction, other samplers also are used on the concentrate.

A New V-Belt Drive

A new V-Belt drive has been introduced recently by the Worthington Pump & Machinery Company, Harrison, N. J. It is known as the "Multi-V-Drive" and has been developed in conjunction with the Goodyear Tire & Rubber Company. It consists of a number of endless molded rubberized-cord V-belts runing in an improved V-grooved sheave. The belts are of Goodyear Emerald Cord make, the load being carried by high-grade cotton cords arranged in parallel lines and concentrated about a neutral axis. Each belt in the drive takes an equal share of the load. Should one break, the rest will carry the load until replacement is made.

Maximum power transmission efficiency has been secured, according to the makers, by the design of the sheave,



This improved lubricant compressor can deliver grease at pressures as high as 5,000 lb. per square inch

which is so grooved, machined, and finished that the grooves present a smooth surface to the belts. Wedging action between belt and groove results in a non-slipping grip. There is an exact mathematical relationship between groove and belt. The combination afforded transmits about 99 per cent of the applied power at high speed ratios, over short centers without idlers. The new drive possesses all features characteristic of short-center drives of this type.

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Tungsten Carbide Improves Circular Saw

Circular saws tipped with tungsten carbide will operate at speeds and feeds far beyond the range of high-speed steel without losing their cutting edges or clearances and will produce from 10 to 50 times the work for sharpening, depending upon the material to be cut, according to C. M. Thompson, products engineer of Henry Disston & Sons, Philadelphia, at the recent semi-annual meeting of the A.S.M.E. in Detroit. Application of the new material has necessitated changes in saw design. Former theories and practices have had to be largely discarded, according to the speaker, and a new start made in order to design teeth able to support the tungsten carbide tip properly and withstand the shocks to which it is bound to be subjected.

The first saw tipped with tungsten carbide was demonstrated publicly in Cleveland in the fall of 1929. This application of the alloy marks the fourth stage in the development of circular saws since their introduction about 150 years ago. Up to 1840 only solid saws were available. Then came the carbon-steel and high-speed steel inserted-tooth saws, and next the tungsten-carbide-tipped, inserted-tooth saw. Although the last mentioned high-speed tool, brought out in 1905, was superior to its forerunners, it has been surpassed by the tungsten-carbide tipped tool.

Lubricating the Rock Drill

PRACTICE followed by mining companies in selecting and buying lubricants has been discussed from time to time in these pages. Due consideration has been given the fact that many operators pay little attention to lubrication and that others depend largely upon the advice of some refinery's sales engineer. One source of advice has not been considered heretofore, and that is the machinery manufacturer himself. Should anyone regard this source as prejudiced, a moment's thought ought to create the conviction that the manufacturer will give the best advice obtainable, because of his direct interest in the quality of the service rendered by his product. In the following paragraphs and in subsequent issues, the recommendations made by manufacturers of the different principal classes of mining and milling equipment will be discussed. Of these, the rock drill will be given consideration first.

Rock Drills—The rock drill is probably the most abused piece of fine machinery in general application. Operators are prone to disregard the fact that in its manufacture the limits are held as close as in making the finest automobile parts. As a result of this disregard, drills are handled carelessly, the effects of this being accentuated by bad working conditions underground, especially where lubricant is carried in open containers that catch abrasive dust and rock particles.

Often too little attention is paid to the selection of drill lubricants. At times the neglect goes so far as to countenance the re-use in drills of oil used by compressors, pumps, and automobiles. The resultant repair costs may be many times the cost of using lubricants of proper quality.

A prominent drill manufacturing company, whose experience may be considered fairly typical, has tested many lubricants in the past to determine which of them it might recommend to its customers. About three years ago, however, it stopped sending out a list of preferred lubricants with its drills, as the list had become too long and the drill company was beseiged with requests to test other oils and greases. Now it makes recommendations to customers only on specific request. However, it does recommend certain specifications to oil companies to guide them in supplying customers. These are as follows:

For light drills, including light sinkers, light drifters, light stopers, paving breakers, sharpeners, and shank and bit punches, an oil should be clear and free from suspended matter and water. It should form a slight emulsion with either air or water, to keep it from washing off the bearing surfaces. As for acidity, not more than 3 mg. of potassium hydroxide should be required to neutralize 1 g. of the oil. Flash point, viscosity, and pour test should be as follows:

Flash Point (Cleveland open cup)	350 deg. F. Min.
Viscosity at 100 deg. F.	300 to 700 Sec.
Pour Test	15 deg. F.

For heavy drills, including tools of the drifter type, heavy stopers, with both rifle bar and independent rotation, and also for air hoists, the specifications should be the same as those given above for light oils, except that the viscosity should be 500 to 900 sec. A liquid grease of good quality may be used in heavy drills provided one be chosen that will pour readily at the temperature of the working place.

The specification as to viscosity is one of the most important for a rock-drill lubricant. The viscosity should be such that the oil will pour readily at the temperature of the working place. Rock drills are often run in temperatures well below zero, and, on the other hand, up to 100 deg. F. above, and the lubrication requirements necessarily vary greatly between two extremes. It will be noted that the specifications as to viscosity for the light and the heavy drills overlap. Some mines using both light and heavy drills insist on one grade of lubricant for all machines. Under such conditions, it is necessary to recommend an oil of medium viscosity which will not retard the action of the light tools materially and which will still be of sufficient viscosity to stand up under the more severe conditions in the heavy tools.

Specifications given apply to mineral oils and compounded oils. The drill manufacturer referred to does not recommend the use of castor machine oils. Certain oils and greases function better than others by virtue of their particular composition to meet the conditions of temperature and moisture which prevail. In other words, if the air is moist, a compounded oil will lubricate more satisfactorily by emulsifying with the moisture than will an oil which is pure mineral and will not therefore emulsify. The same machine would perhaps be better lubricated with the pure mineral oil if the moisture were eliminated.

(To be continued)

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Standardization Progresses

New standards approved by the American Standards Association during 1929 include important mechanical standards, such as tool-holder shanks and tool-post openings, according to W. V. Serrill, president. In the electrical field, besides the standard for outlet boxes, there is a new standard of regulations for electric wiring and apparatus in relation to fire hazard, the code for protection against lightning, and the first national standard for radio. The railroad industry is represented by a new standard for materials for use in the manufacture of special track work. Of interest to almost all engineers is the new standard for symbols for hydraulics, aeronautics, for electrical quantities, and for telephone and telegraph use.

New projects initiated during 1929 include such subjects as annular ball bearing, methods of laboratory sampling and analyses of coal and coke, standardization of Diesel fuel oils, specifications for coal mine cars and for mine timbering, and locomotives for coal mines. Hundreds of foreign standards, new and old, have been loaned to American manufacturers and trade associations.

Personal Notes

COL. H. H. STOUT

Col. **H. H. Stout** consulting metallurgist, has moved his office to 40 Wall St., New York. Although Colonel Stout resigned recently as consulting metallurgist to Phelps Dodge, he will continue to devote some of his time in a consulting capacity to that company.

Huntington Adams is in South Africa.

Kilian E. Bensusan arrived in New York recently from South America.

Bernard N. Zimmer, vice-president of American Metal, sailed from New York for Europe on July 16.

H. C. Goodrich, chief engineer of Utah Copper, has been elected president of the Utah Society of Engineers.

Dr. **Otakar Matousek,** professor of geology, Charles University, Prague, Czechslovakia, is in the United States.

John R. Turner, of Duthie Mines, Ltd., is now in charge of operations at Jack Waite Mines, near Wallace, Idaho.

Tom Fraser, shaft contractor, of Ray, Ariz., is a candidate for the office of State Mine Inspector in the coming fall election.

Van Dyne Howbert, vice-president of American Metal, returned recently to New York from a trip to Mexico and the Southwest.

Harry S. Thayer has been appointed consulting engineer of the New York Mining Exchange, with headquarters in New York City.

Lloyd C. White, of San Francisco, manager of Yellow Pine, has returned after a month spent at the company's property in Idaho.

Dr. **Arthur Keith** is representing the National Research Council of the United States at the centennial of the French Geological Society.

M. Russakoff, senior geologist of the Central Geological Committee of the U. S. S. R., recently arrived in New York from London.

M. W. Hotchkin has been appointed manager in charge of operations at the Tough - Oakes - Burnside property, at Kirkland Lake, Ont.

Prof. **James G. Lawn** has been elected president of the Institution of Mining and Metallurgy for 1930-31, in succession to Dr. **William Cullen.**

Cornelius F. Kelley, president, and **John D. Ryan,** chairman of the board of directors, of Anaconda Copper, are spending the summer in Montana.

Albert H. Fay left Moscow on June 30. After a three weeks' stay in London he will proceed to New York, where he expects to arrive on about Aug. 1.

Thornton Emmons has been elected vice-president in charge of sales of American Zinc, Lead & Smelting. His headquarters will be in Columbus, Ohio.

W. L. Cumings, geologist, with the Bethlehem Steel Company, sailed from New York on July 10 for Chile. He expects to be gone for three or four months.

Ernest E. Thum, for three years associate editor of *Iron Age,* has resigned to become editorial director of *Metal Progress,* to be published by the American Society for Steel Treating.

T. H. O'Brien, general manager of Inspiration Consolidated, who returned recently from Europe, will deliver an address on his trip before the Globe, Ariz., chamber of commerce.

H. G. Ferguson and **W. D. Johnston, Jr.,** geologists with the U. S. Geological Survey, are at Grass Valley, Calif., making a study of geological conditions underground at the North Star mine.

Dr. **Philip J. Shenon** has resigned as associate professor of geology at the Montana School of Mines to become head of a field party of the U. S. Geological Survey that will start work near Grants Pass, Ore., in the near future.

F. K. M. Hunter, until recently with the Keith Dunham Company, working on liquid oxygen explosives, has been admitted to partnership in the New York stock exchange firm of Jacqueline & de Coppet.

L. C. Penhoel, president of Southwest Engineering, of Los Angeles, is making an extensive business trip which he will terminate at the New York office of his company, where he expects to remain for several weeks.

J. N. Davis, formerly assayer for West End Consolidated, and who more recently maintained an assay office in Tonopah, Nev., has been appointed superintendent of Gold Hill Development, at Gold Hills, Nev.

A. J. Keast has been appointed general manager of Amulet mines, in the Rouyn district of Quebec, succeeding **Jay Tuttle,** resigned. Mr. Keast was formerly manager of Continental Kirkland Mines, in the Kirkland Lake district of Ontario.

J. U. Sebenius retired July 1 as general mining engineer for Oliver Iron Mining, subsidiary of U. S. Steel. He was born in Sweden in 1862, and was made mining engineer for Lake Superior Consolidated in 1898. When it was taken into U. S. Steel, he was appointed mining engineer for Oliver.

S. J. Cook, chief of the Mining, Metallurgical and Chemical Branch, Dominion Bureau of Statistics, Ottawa, has been appointed general secretary of the Fifth Pacific Science Congress, which will meet for the first time in Canada in 1932.

V. M. Kreiter, senior geologist of the Central Geological Committee of the U. S. S. R., returned on July 23 to his headquarters in Leningrad after six months in the United States. During this period Mr. Kreiter visited the more important mining centers, and made a study of ore deposits and methods of prospecting.

Edgar Bush has been elected secretary of the Los Angeles chapter of the Mining Association of California. Mr. Bush's first secretaryship was served with the Royal School of Mines Association in Johannesburg in 1893, when the Witwatersrand district was being developed. Later he was associated with Robert Williams as a mining engineer in Northern Rhodesia and still later with John Hays Hammond on the technical staff of Consolidated Gold Fields.

E. J. RISTEDT

Ernest J. Ristedt, formerly with Old Dominion and Inspiration Consolidated, in Arizona, and later ventilation and safety engineer for Mexico Mines of El Oro, sailed from New York on July 18 for Peru, to take charge of safety work for the Cerro de Pasco Copper Corporation, with headquarters at Oroya.

OBITUARY

Robert T. Chapman, mine owner and operator, died at his home in Joplin, Mo., on July 6. Mr. Chapman, who was 57 years of age, was in the banking business in Springfield, Mass., as a young man.

Frank P. Botsford, assistant mine manager in Minnesota for Pickands, Mather & Company, died recently at Hibbing, Minn., after a short illness. He was 52 years old and had been in the employ of the company since 1901.

Edward W. Shemin was killed at the Iowa Tiger mine, at Silverton, Colo., on July 8, when a tram bucket in which he was riding was struck by a runaway bucket. Mr. Shemin, who was a resident of Colorado Springs, was inspecting the operation of a special type of drill bit, which he had invented recently.

W. Howard Moore died at his home in Wallace, Idaho, on Monday, July 7, as a result of an automobile accident on the preceding Saturday. For the last two years Mr. Moore had been manager of the Big Three Mining Company, which holds several leases in the Coeur d'Alene district. He and his associates were also interested in other properties in the district.

NEWS OF THE INDUSTRY

May Build Liverpool Plant to Refine Rhodesian Copper

Construction of a 200,000-ton copper refinery at Liverpool, England, is being considered by British Metal Corporation. The plant, which would be available late in 1931, would handle blister copper from Northern Rhodesia, where the Roan Antelope, N'Kana, and Mufulira mines are being equipped with concentrators and smelters. At present Bwana M'Kubwa, the only copper producer in Rhodesia, does not refine its copper electrolytically.

Production of 200,000 tons of copper annually in England would leave a surplus of about 40,000 to 50,000 tons for distribution in Europe. At present only two small refineries are being operated in England, and the production of copper is negligible. British Metal, through its affiliated company, Amalgamated Metal, is in close contact with the Metallgesellschaft, the leading German metal producer, and the Société Générale des Minerais, of Belgium.

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Expect Mayflower Tunnel to Cut Fissures Soon

The Mayflower tunnel, in the East Park City district of Utah, has been advanced 1,800 ft. This tunnel, 7x8 ft. in the clear, recently cut a 40-ft. fissure carrying mineralization. Within a short distance the tunnel should cut the sedimentary and other fissures showing in the diorite on the surface. The main objective of this work is to explore the fissures containing ore opened up in the old Park Bingham workings. A modern hotel building has been erected. Equipment consists of a Sullivan two-drill compressor, a 40-hp. General Electric motor, a Gardner-Denver drill sharpener, a power saw, and a blower.

The Star of Utah tunnel on adjoining property has been advanced to a point 7,800 ft. from the portal. Within the next sixty to ninety days, John D. Fisher, superintendent, expects to cut the Wabash, the Naildriver and New York, and the Wasatch fissures in the sedimentaries. These properties lie on the west side of the district, but water trouble and the lack of adequate tunnel sites have necessitated driving the Star of Utah tunnel to cut the formation 600 ft. below the 800 level of the old Wabash shaft. The company has an Ingersoll-Rand compressor, a Roots' company rotary blower, and a Sullivan drill sharpener.

At the adjoining Park Galena, operations are centered on the 500 level, where the company is stoping 120 tons of ore weekly. It assays 16 per cent lead, 5 per cent copper, 6 to 7 per cent zinc, $2.50 gold, and 16 oz. of silver to the ton. It is coming from the Glencoe fissure, in which ore has been opened up for a length of 400 ft. Drifts are also being run on this level to cut the Pear 1 and the Thirty-Foot fissure. L. F. Pearce is superintendent.

Fire Destroys Ellison Shaft Surface Plant at Homestake—Cuts Output Temporarily

Two Men Lose Lives, Much Damage Done in Disaster at Gold Mine in South Dakota—Expect Shaft to Be in Operation in Three Months—Full Production Reached Sooner

TWO men lost their lives, six men were injured, and three buildings were destroyed in a fire that swept the surface plant at the Ellison shaft of Homestake Mining, largest producer of gold in the United States, near Lead, S. D., on July 10. The extent of the damage done has been variously estimated at from $500,000 to more than $1,000,000. In addition to the destruction of property, the fire will mean a temporary reduction in output of about 25 per cent, according to B. C. Yates, general manager of the company, in response to an inquiry from *E.&M.J.* Reconstruction work is already under way at the property, and the shaft is expected to be in operation for hoisting ore in about three months. Full production will be resumed soon, however, as other shafts will be used to handle the ore.

Fortunately, the fire was confined entirely to the surface, destroying the hoist house, compressor house, and dry room. About 600 men at work in the mine were conveyed to safety by means of ladders and hoists. The two men killed were in a cage at the 300 level at the time that the fire broke out, and they were plunged 2,000 ft. to the bottom of the shaft.

Most of the tonnage milled by Homestake, now slightly more than 4,000 tons daily, has been handled through the Ellison shaft, which is 2,300 ft. deep, has five compartments, and measures 12x20-ft. outside the timbers. It was equipped with an Allis-Chalmers electric hoist that had a capacity of 4,000 tons in fifteen hours and that had a rope speed of 2,000 ft. per minute, handling seven-ton skips.

The only other operating shafts at the Homestake previous to the fire were the B. & M. and the B. & M. No. 2, which is 1,000 ft. east of the B. & M. Five other shafts are available, however, and possibly the management will use some of these until the Ellison shaft is again usable. Production has been about $6,500,000 annually for several years, the average grade of ore being $4.50. A 25 per cent reduction over a period of three months would mean a loss of only about $400,000 in output, and Mr. Yates' statement indicates that the loss as a result of the fire is likely to be even smaller.

Development work at the Homestake mine at depth is said to have been quite successful recently. Ore reserves actually blocked out on Dec. 31, 1929, were 15,176,740 tons, a small gain over reserves at the end of 1928, despite extraction of 1,437,935 tons during the year. The property has been producing continuously for more than fifty years and the workings have now reached a depth of 2,600 ft. At that depth, development has given encouraging results, according to Mr. Yates.

Swansea Operating at Capacity

The mill at the Swansea mine of American Smelting & Refining, north of Bouse, Ariz., is now treating 250 tons of ore per day. Additional ore is reported to have been discovered in the mine. A change of flotation reagents in the concentrator has resulted in an improvement in extraction.

■

Continue Tunnel at Alma, Colo.

McDowell Mines, which has secured from Rilla Mining the right to use the 2,000-ft. tunnel driven by the latter company on the property adjoining the McDowell holdings near Alma, Colo., is now continuing the tunnel into its own ground. R. W. Gallup, superintendent of McDowell, expects to cut the veins that outcrop on the surface within 100 ft. and at a depth of 700 ft. from the surface. A new Ingersoll-Rand compressor has been installed at the property, and power is being furnished by the Public Service Company.

Los Angeles Miners Meet

The first regular meeting of the Los Angeles chapter of the California Mining Association was held recently at the Engineers' Club. A constitution, prepared by W. R. Law, E. D. Foster, and B. M. Stansbury, was adopted. Additional members in the chapter are urgently desired. Nominations are to be sent to Edgar Bush, mining engineer, who is secretary of the organization, at 1,024 South Beacon St., Los Angeles.

■

New Group Controls Blue Ledge

The Blue Ledge copper mine, 40 miles from Medford, Ore., recently sold by American Smelting & Refining to Consolidated Copper, which had headquarters in Medford and was composed of Puget Sound operators, has passed into the hands of a California group. Col. Frank M. Leland, of San Francisco, will be general manager. He plans immediate construction of mill and power plant.

Thomas Estimates Bagdad Ore at 48,000,000 Tons

Diamond drilling and drifting in the Bagdad orebody of Bagdad Copper, at Hillside, Yavapai County, Ariz., indicate 48,000,000 tons of ore at the present stage of development, according to George J. Thomas, general manager. The grade of the ore is not given. During the period from Jan. 1 to May 31, a total of 11,623 ft. of development was completed. Contracts call for 4,800 ft. of additional diamond drilling, which should add materially to the estimated tonnage, Mr. Thomas believes. Exploration to date has indicated a minable thickness of 270 ft. of ore. Drifting proved the orebody for 1,600 ft. east and west and 1,000 ft. north and south. These drifts have not reached the limits of the Bagdad orebody in any direction. They average 1.5 per cent copper for the 2,600 ft.

A block of ground, 100 ft. square, near the southeastern ore boundary is being prepared for stoping. The Miami caving system will be applied to this stope, and from its operation much information as to actual costs and physical characteristics of the ground should be obtained. General Electric storage-battery locomotives have been installed underground for use in development work.

Expansion of mill capacity to 200 tons has been completed and it is being operated at 150 tons pending the completion of the stope. Milling operations since the first of the year averaged an 84.4 per cent copper recovery. The company expects to produce electrolytic copper from concentrate by roasting and leaching, according to its present metallurgical program.

A power-line survey was made from the Arizona Power Company's main line east of Kirkland to the mine, a distance of 37 miles. Power requirements are at present supplied by a Diesel-engine installation developing 975 hp., direct-connected to alternators totaling 643-kw. capacity. Contours have been completed for a dam and water-storage area. Among general surface improvements and additions are a new steel-sharpening shop; new mine change house; rehabilitation of the camp water-supply system; a new hospital in charge of a resident physician and surgeon; and new houses. Since the first of the year an average of 135 men has been employed.

■

Gould Leases Quicksilver Mine

The Mexican quicksilver property northwest of Coalinga, and 9 miles southeast of Idria, Calif., has been leased by H. W. Gould & Company, of San Francisco. Work was started on July 1. The mining claims were originally located in the 'sixties. Formations at the Mexican property are said to be similar to those at the New Idria mine, which has been the largest quicksilver producer in California for several years.

■

Silver Shield Work Continues

Sinking of the Independence shaft of Silver Shield Mining & Milling, in the Tintic district, Utah, has been completed to 1,250 ft., according to a progress report issued by the company. The bottom of the shaft is in a quartz formation, carrying small quantities of silver, gold, and copper. It will be continued to 1,600 ft. At the Copper Jack and Flying Dutchman group, the tunnel has been driven 700 ft., having cut two low-grade copper veins. Diamond drilling, consisting of five holes totaling 1,400 ft., has been completed. Low-grade copper oxides were indicated in all holes. No further work is being done at this property, because of the fall in the price of copper.

■

Will Exhibit Old Equipment at Tombstone Celebration

An unusual mining exhibit will be one of the features of the 1930 "Helldorado" celebration at Tombstone, Ariz., if present plans of the committee in charge materialize. Those who attend this celebration in October will be given an idea of the manner in which mining was carried on in the days when Tombstone sprang into being. The days of the rawhide ore bucket are to be revived, and demonstrations of the manner in which this old-time piece of equipment functioned will be given. Some old machinery from the mines of the neighborhood will be set up to demonstrate early-day metallurgical processes. So that these demonstrations may be compared with modern mining methods, other eaxhibits will be of the most scientific in modern mining machinery.

■

Aramayo Tunnel Completed

At the annual meeting of Aramayo Mines, held on June 30, in Geneva, Switzerland, Carlos Aramayo, president of the company, reviewed the situation at the properties in Bolivia. Driving of the new Chorolque tunnel to connect with the San Bartolomé shaft was completed in February, and the volume of water flowing out of the tunnel is now 3,500 g.p.m. Drifting on the 100-m. level of the mine has been resumed and low-grade tin oxides have been opened up. The flooding of this level in 1926 caused suspension of operations below 65 m. and was the cause for driving the new tunnel. At the Chocaya unit, drifting on the 302-m. level of the Central shaft has disclosed high-grade silver ore. Because of the voluntary curtailment scheme, the Telamayu mill, at Chocaya, has handled an average of only 100 metric tons daily during the first five months of the year.

■

Water Hinders Tom Reed Drift

Drifting on the oreshoot at the 1,100 level of the Tom Reed Gold property, near Oatman, Ariz., has had to be suspended because of the large flow of water. After work was suspended, the water rose to a height of 65 ft. above the level. A new pump column is being installed between the 800 level and the surface, and as soon as this installation is completed, work will be resumed on the 1,100 level, as pumping capacity will then be sufficient to handle the flow. The crosscut intercepted the vein shortly before the flow started. Drifting for about 25 ft. had shown the orebody to be 5 ft. wide and of good grade. Production from the 800 and 950 levels is continuing.

Pecos Raising Production to 450 Tons Daily

DEVELOPMENT work at the Pecos mine of American Metal, at Glorieta, N. M., is going forward at a normal rate. The tonnage of ore handled in the concentrator is being raised to about 450 tons daily, to compensate for the continued decline in the price of zinc. In January, the company cut output from its capacity of about 600 tons to 350 tons daily.

Sinking of the main three-compartment shaft at Pecos has been completed to the No. 10 level and stations have been cut on both the Nos. 9 and 10 levels. The company is now engaged in completing a pump sump to handle the increased water flow. When this work is finished, by the end of July, crosscutting to the orebodies will be started.

At Pecos, the orebodies occur in two main shear zones—the Evangeline and the Katydid. In the Evangeline shear zone, the Cucaracha and Evangeline orebodies have been developed, the former being south of and the latter north of the main shaft. In the Katydid shear zone, the Katydid orebody has been developed west of the main shaft. This orebody has been responsible for most of the recently increased water flow, and on the No. 7 level work in the Katydid section has been suspended for the time being. A new 1,000-g.p.m. electric pump has been ordered, and work will be resumed in the Katydid on the lower levels when the pump has been installed on the No. 10 level.

Within the last year or so, development and drilling at Pecos have proved the existence of the Cucaracha orebody over a length of several hundred feet on Nos. 5 and 6 levels and indicated its continuance to a depth of 1,100 ft.; have established the continuation of the Evangeline orebody, now the principal source of ore, to greater depths; and indicated ore in the Katydid shear zone on the No. 9 level, although the Katydid orebody appears to pinch out somewhere between the Nos. 6 and 8 levels.

The Evangeline orebody is proving to have a higher lead and lower zinc content on the No. 8 level than on the levels above. As a result, mill heads have been running about 4 to 5 per cent lead, instead of 3.5 per cent as in the past, and about 15 per cent zinc. Drill holes indicated high-grade ore on this level, but subsequent development has shown the grade to be somewhat erratic, possibly as a consequence of post-mineral faulting. The Evangeline orebody has not yet been completely delimited to the north at this depth, and development is being carried out there.

Work on No. 8 level has shown ore in the Evangeline shear zone between the Cucaracha orebody, south of the main shaft, and the shaft itself. The precise relation of this ore to the main Cucaracha orebody has not been determined, but the drifts that will be driven from the shaft on Nos. 9 and 10 levels are expected to make its importance more clear.

During May the tramway traction cable was replaced without any interruption to milling operations. This change involved installing 120,000 ft. of new cable.

■

Add to Italian Aluminum Plant

Three 8,500-amp. mercury-arc rectifiers will be installed by Brown Boveri at the Porto Marghera aluminum plant of Societa Allumino Veneto Anonima, near Venice, Italy. The plant has a capacity of 1,500 to 2,000 tons annually.

Santa Maria to Continue Work With Wage Cut

Rather than force complete suspension of operations at the Santa Maria de la Paz property, at Matehuala, San Luis Potosi, Mexico, the Mexican government has granted the company permission to cut wages of all employees earning more than two pesos a shift. Because of the low price of silver, its principal product, the mine had made application to the Department of Industry, Commerce and Labor for permission to suspend operations. The wage cut will amount to 20 per cent. In 1929, Santa Maria de la Paz produced 5,540,345 oz. of silver, as well as some lead, gold, and copper. Ore is shipped to the Matehuala smelter of American Smelting & Refining for treatment. The company is the largest Mexican-controlled producer of silver in the country.

Wage cuts, rather than suspension of operations, are being generally resorted to throughout Mexico by companies financially able to continue working during the present depression. In most cases, the agreements as to decreases have been reached after joint consultation by the managements and labor leaders. Application to government officials for permission to cut wages is resorted to only when joint agreement fails, as government action is sometimes not forthcoming for a considerable period of time subsequent to the filing of the appeal for sanction to reduce the wage rates.

■

Mazapil Copper Applies for Permit to Curtail Output

Reports that Mazapil Copper, operating properties in Zacatecas, Mexico, had applied for permission to shut down completely are incorrect, but the company has applied to the Mexican government for permission to cut down working forces at its Arazanzu and San Eligio mines, as well as at the smelter at Concepcion del Oro. No action has yet been taken on the application. The company produces about 6,000 tons of copper and an equal amount of lead annually. More than 2,000 men are employed.

■

Propose Merger of Option With Dayrock Holdings

A special meeting of stockholders of Option Mining has been called to meet in Wallace, Idaho, on Aug. 12 to consider a proposition from Dayrock Mining for purchase of its property, consisting of the Ohio and Pacific patented claims. About four years ago, an important ore discovery was made by Option Mining on the Ohio claim, which has a common sideline with the Dayrock property on the south. In 1927, Dayrock secured a lease of the Ohio claim, running for five years with privilege of renewal, Option to receive 12 per cent royalty on all shipments. Thereafter Dayrock started buying Option stock on the open market and soon acquired a majority. The next step was to take over control by electing a Dayrock board of directors, thus placing Dayrock in the dual position of lessor and lessee of the Ohio claim. Little has been heard of Option or the Ohio lease since this transfer of control.

The proposal is to give Option 36,000 shares of Dayrock stock for the property or to pay $72,000 in cash. Directors of Option point out that Dayrock owns about two-thirds of Option stock and that this stock will be voted in accordance with the wishes of the majority of the one-third of the issued option stock not owned by Dayrock.

■

Gold Coin Buys New Group in Granite County, Mont.

Gold Coin Mining, which has been developing the Hoffman group, near Maxville, Mont., has recently taken over the Sunrise group, near Stone, on the Northern Pacific Railroad. Both properties are in Granite County. The Sunrise group, consisting of 42 claims formerly owned by the C. D. McLure estate, has not been worked for several years, because of litigation. It is said to have produced about $500,000 gross in copper and gold, with gold predominating. Not fewer than 27 adits and tunnels have been driven on the vain, proving it for 3,000 ft. on the strike, according to R. E. Tower, who is in charge of operations. Both oxide and sulphide ore have been cut, the deposit being a replacement vein in limestone.

Contracts have been made to drive a new tunnel at the Sunrise. Additional work will be undertaken through diamond drilling. A power line will be constructed to connect with the main line of Granite County Power. If development is successful, a rope tramway will be constructed to transport ore to Gold Coin, where the company has a leaching plant and where a cyanide plant will be built.

Development of the Hoffman group is being centered on a large body of oxide copper, which the company expects to treat at the Gold Coin leaching plant. Some high-grade ore extracted in development is now being shipped to the Anaconda Copper smelter at Anaconda.

■

Reopen Pioneer Tin, But Most Tasmanian Mines Close

Operations have been resumed at the property of Pioneer Tin, in Tasmania, Australia, but most of the other tin mines on the island are closing, as the present price of the metal is too low to warrant continued production. Briseis Tin, which has been operating near Derby since 1900, has decided to go into voluntary liquidation, its workings having been partly destroyed by flood last year. At the Pioneer, the main excavation has been unwatered and sluicing has started on a small area near the site of No. 2 electric barge. Production will be only from the better grade areas, as full-scale operation would not be profitable at present tin prices.

■

Arcadian Starts New Drill Hole

Arcadian Consolidated has finished drilling into the hanging wall and has started the second hole in the footwall at its property near Houghton, Mich. The first hole cut the formation from the 1,950 level for a distance of 1,000 ft., no veins carrying any copper having been disclosed. The second hole will cut No. 8 conglomerate and provide an opportunity to study the extent of the fault which threw both the New Arcadian vein and No. 8 conglomerate out of position. The hole will go down about 1,000 ft.

Hecla Obtains Control of Polaris, Near Sunshine

Hecla Mining, of Wallace, Idaho, having purchased control of the Polaris Development & Mining Company, preparation is now being made for active development of the Polaris property, in what is commonly called the "dry-ore belt" of the Coeur d'Alene district. The Polaris is southeast of and joins the Sunshine mine, and the Polaris is one of the two veins that produce the rich silver ore for which Sunshine is locally famous.

Polaris was located many years ago. It was then credited with shipments to the amount of probably $250,000. Operations are high up on the mountain and the cost of production and transportation made profit difficult even with silver at $1.

Plans of Hecla have not been made public, its activity so far being confined to surveys both underground and on the surface. The location of the property is favorable for deep development by crosscut tunnel, and it is believed that this plan will be adopted rather than sinking from the present tunnel. The latter would involve heavy expense, not only in sinking but also in delivering lumber for buildings, heavy operating equipment, and the usual material and supplies at that high elevation.

■

Pine Creek Starts Mill But Other Idaho Mines Close

On July 15, operation of the new 250-ton flotation plant of Pine Creek Lead & Zinc at its Little Pittsburgh mine, in the Coeur d'Alene district of Idaho, was started. Several small producers in the district, on the other hand, closed their properties early in July because of prevailing low metal prices. Among the mines to close were the Gold Hunter, the Constitution, the Jack Waite, and the Sidney.

Driving of No. 3 tunnel at the Little Pittsburgh property last fall proved the continuation of ore exposed in No. 2 tunnel. A raise is now being put up to connect the two levels, which are 160 ft. apart. The mill is of fireproof construction, as are the other surface buildings, including a boarding house with accommodations for 50 men. M. L. Savage and Herman Rossi are in charge of the work.

About 360 men were employed at the four properties that closed down, of whom probably one-fourth will be retained on development work. Gold Hunter had been handling about 300 tons of ore daily in its plant. Suspension of operations may affect Atlas Mining, which had just completed construction of a tramway to the Gold Hunter mill to permit treatment of ore from development. Constitution, Jack Waite, and Sidney were each producing about 150 tons of ore daily. Only the Constitution has an appreciable zinc content in its ore, the other properties producing only silver and lead.

■

Argonaut Makes Another Strike

A strike of high-grade ore has been made in the north drift on the 5,500 level of Argonaut Mining, near Jackson, Calif. The orebody was encountered in drifting, but its extent is unknown and its importance cannot be determined until further development has taken place. Argonaut recently cut ore in shaft sinking at about 5,600 ft.

Oddie Suggests Conference on Silver in December

Calling of a national conference to consider the silver situation, which would meet in Washington on Dec. 9-11, has been proposed by Senator Oddie, chairman of the Senate Committee on Mines and Mining, to Secretary of Commerce Lamont. Mr. Lamont will hold the proposal under advisement until it is learned definitely whether, as reported, an international conference will be held in Mexico in the fall. In reply to Senator Oddie, Secretary Lamont stated that such a conference might be helpful, but only if a program with very definite objectives is prepared in advance.

In suggesting that a conference should be called, Senator Oddie expressed the belief that because of the serious and delicate conditions which prevail in some foreign countries with reference to the silver situation, discussion should be limited to the consideration of the domestic problem. Senator Oddie is confident that such a conference would produce much valuable information that would be helpful to the U. S. Bureau of Mines and the U. S. Bureau of Standards in mapping out their research programs to be financed by an appropriation of $50,000 that Secretary Lamont will recommend for inclusion in the Commerce Department's 1932 budget.

The date suggested for the conference will coincide with that of the hearing before the Joint Congressional Committee on Internal Revenue Taxation, when silver producers will appear to present their views on the problem of computing depletion in ore reserves for tax purposes.

Senator Oddie has advised Secretary Lamont that if the conference is called he would like to have an opportunity to present for consideration a resolution introduced in the Senate May 12 last providing for a revision to date and republication of the currency and financial research work of the Senate Commission of Gold and Silver Inquiry and the extension of its research to the countries of Latin America and to the Orient. Senator Oddie stated that following the publication of the commission's original reports several countries provided for the minting of new silver coins. Probably similar activity would result from further research work provided for under his resolution, he said, thereby increasing the monetary demand for silver.

Secretary Lamont has recently advised Senator Oddie that he will recommend an appropriation of $50,000 for inclusion in the department's 1932 budget to carry on research looking toward wider utilization of silver in art and industry. This sum, which will be divided equally between the U. S. Bureau of Mines and the U. S. Bureau of Standards, is not as large as that recently suggested for the purpose by Senator Oddie, but probably more funds will be sought if the first year's work develops any promising leads. Senator Oddie had proposed that $50,000 should be made available to the Bureau of Standards and $25,000 each to the Bureau of Foreign & Domestic Commerce and the Bureau of Mines.

The fund of $50,000 on which Secretary Lamont will ask the Budget Bureau's approval will not become available until July 1 of next year.

■

Walker Lease Ships High-Grade

Grade of the last carload of ore, totaling about 30 tons, shipped from the Walker lease, in the American Eagles mine of United Gold Mines, at Cripple Creek, Colo., was 4.96 oz. of gold per ton or about $99. The shipment was made early in July. Operations of the leasers are being conducted through the 2,100 level of the Eagles mine, with the back of the stope now about 110 ft. above that level.

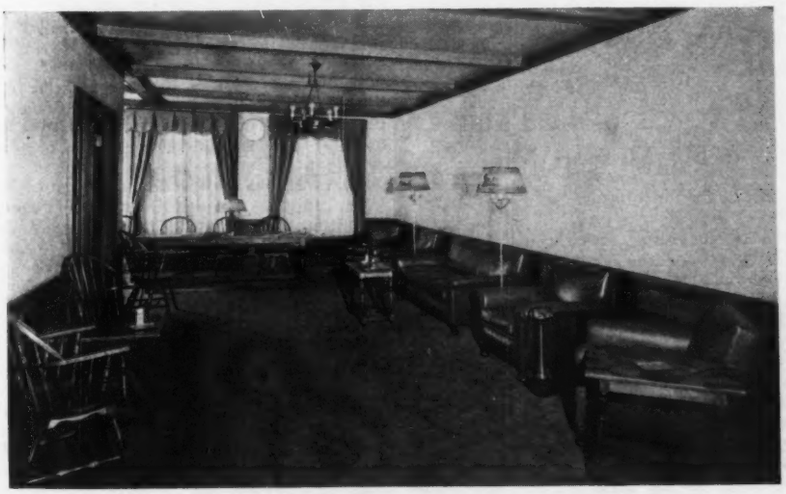
Shipments from the Walker lease, operated for a little more than a year, have varied widely in grade. Gross production up to June 1, 1930, was $30,940 from 848 net tons shipped, or an average grade of about $36.30 a ton. For one month, shipments averaged only $13.50 a ton, whereas last January they averaged $110 a ton About 65 to 70 per cent of the ore mined is hand sorted before shipping to the Golden Cycle mill, at Colorado Springs, so that extraction to date actually has been close to 3,000 tons.

■

Lake Superior Institute to Meet

The 28th annual meeting of the Lake Superior Mining Institute will be held in Minnesota in September. The details of plans will be worked out by the committee on arrangements, of which F. J. Garvin and E. J. Maney, of Duluth, are chairman and vice-chairman, respectively. Capt. John H. Hearding, of Duluth, is president of the Institute.

Lounge room of New York's new Mining Club, furnished by the Regan Office Furniture Corporation



All Operations Suspended at Engels Copper Mine

All operations at the Engels Copper mine, in Plumas County, Calif., have been closed down, according to official advice from the company. Resumption of work will depend on improvement in the copper market. Engels was the second largest producer of copper in the state in 1929, ranking after the Walker Copper property. Development work has recently been unsatisfactory, and at the end of 1929, despite a large amount of work done, reserves were only 311,849 tons of ore.

In 1929, the total cost of producing copper at the Engels property was 17.994c. a pound, compared with 15.838c. a pound in the preceding year. The increase in development work has been chiefly responsible for this rise. With the price of copper at 11¼c. a pound, the company would have lost considerable sums if operations were continued. Production in 1929 was 11,000,162 lb. of copper from 395,042 tons of ore. About 300 men were employed.

■

Geologists to Meet at Butte

The Association of American State Geologists, composed of chief geologists in 41 states, will hold its annual field conference in Butte on Tuesday, Aug. 26, during a six-day field trip through the Montana Rockies, according to Dr. Francis A. Thomson, president of the Montana School of Mines, who will act as host to the association.

Dr. Eugene S. Perry, head of the geology department at the local institution, who is assisting Dr. Thomson in completing arrangements for the conference, says that more than 20 state geologists are expected to attend this year's meeting. Present plans for the field conference include a tour of the Montana Rockies, with visits to both Glacier and Yellowstone National Parks and a business meeting and banquet to be held in Butte.

■

Lease Strikes Ore at Tonopah

An important strike, in which half of the metal content is gold, has been reported from the Tonopah Belmont Development property at Tonopah, Nev. It was made in a winze, 35 ft. below the 1,000 level, in an area operated under lease by Tom Morrison, who is backed financially by Harry Polin, a newsdealer of Tonopah. Early in June the Belmont property was leased to Fred Ninnis, H. D. Budelman, and Homer O'Connell, who in turn have subleased the ground. A small hoist is now being installed at the collar of the winze in which the strike was made.

■

Discuss Pacific Coast Resources

On July 15, the Mid-Pacific Empire Mineral Economic Conference, sponsored by the Northern California-Southern Oregon Development Association, with headquarters at Medford, Ore., held a meeting at Grants Pass, Ore. Papers on gold, copper, mineral resources of northern California and southern Oregon, coal and silica, chromite, financing, limestone, carbonic acid, and clay and clay products were read.

Ontario Refining in Operation

The first refined copper to be produced in eastern Canada will soon make its appearance as a result of the initial operations of the Ontario Refining plant, at Copper Cliff, Ont. It was erected under the joint control of International Nickel, American Metal, and Consolidated Mining & Smelting, with Ventures, Ltd., participating. Construction work in connection with the new refinery is nearing completion and blister copper from the Port Colborne refinery of International Nickel, where separation of the copper and nickel is still being made, is now going into process. About 5,000 tons of blister copper is now on hand, chiefly from Frood ores. With one anode-casting furnace operating, the process of changing from construction to operation is in steady progress. The end of July will see the greater part of the Fraser-Brace program completed and a considerable reduction will take place in construction crews. When operating at capacity the plant will employ about 800 men. The company is retaining some of the construction employees and is training them for the various operating departments.

■

Falconbridge Still Inactive

Owing to the almost daily rains, which are aggravating flood conditions on the rivers supplying power to Sudbury mines, the middle of the month found operations of Falconbridge Nickel, in northern Ontario, still suspended, and power was turned on at the Errington mine of Treadwell Yukon only after a suspension of thirteen days. At both properties sufficient power had been available to keep pumps working. Apart from the loss of production, no damage was reported. The High Falls development of International Nickel was also affected, resulting in a temporary reduction of operations at the Creighton mine, but sufficient power is now being supplied to allow these to be resumed at their normal capacity.

■

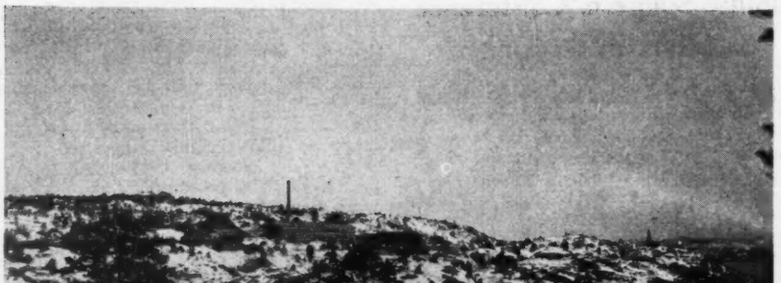
Wilbert Continues to Ship

Despite low silver and lead prices, Wilbert Mining is extracting about 850 tons of ore monthly from its property in the Dome district, Butte County, Idaho. Monthly shipments of concentrate total about 200 tons, assaying 57 to 62 per cent lead and 10 to 15 oz. of silver per ton. Production is coming from the 1,350 level. The shaft has been sunk to 1,450 ft., but no development is being done at that depth, pending an improvement in metal prices. About 300 ft. of development work will be necessary to reach the downward extension of the ore zone, according to J. A. Foley, manager of the company.

■

Jardine Ships Tungstic Acid

Jardine Mining, at Jardine, Mont., near the Gardiner entrance to Yellowstone National Park, shipped a car assaying 74.7 per cent tungstic acid recently, for which it received about $25,000. The Jardine ore contains about 2 per cent arsenic, but this was lowered to 0.03 per cent arsenic by roasting with wood instead of coke.



Falconbridge's nickel refinery in Norway, whence matte from Sudbury is now being shipped

Central Patricia Crosscuts Hit Ore on Four Levels

All four levels driven from the 500-ft. shaft sunk last spring by Central Patricia Mines at its property in the Crow River area, Patricia district, Ontario, have cut the orebody indicated by diamond drilling. Lateral work was started in the middle of June. At 125 ft. the orebody was 6 ft. wide, at 250 ft. it was 4.5 ft. wide, and at 375 ft., 12 ft. wide. Data on the width at 500 ft. are not available. Grade of ore ranges from $5 to $26 in gold a ton. Drifting has started. Diamond drilling has indicated a length of about 600 ft.

■

Iron Mask Mill Bought for Pitt Mine, Near Vancouver

Pitt Mining has bought the 300-ton gravity concentration and flotation mill that was used for several years at the Iron Mask mine, near Kamloops, B. C., has dismantled it, and is now moving it to Pitt Lake, about 35 miles east of Vancouver. The company has developed a considerable tonnage of ore, averaging between 3 and 4 per cent copper and 0.12 oz. gold per ton. Its mill building is finished and the machinery is being assembled as it arrives. The company has also completed and put in operation a 300-hp. hydroelectric plant. Iron Mask, now exhausted, was operated for several years by Consolidated Mining & Smelting.

■

C. M. & S. to Build Mill at Big Missouri Mine

Consolidated Mining & Smelting has announced that development to date on the Big Missouri mine, situated a few miles to the north of the Premier mine, in the Portland Canal district of British Columbia, has justified the erection of a pilot mill to handle ore extracted in development. Erection of the mill will be started immediately, and it is expected to be in operation before the end of the year. A hydro-electric plant will be erected to provide power for mining and milling purposes.

Gold, silver, lead, copper, zinc, and arsenic occur in Big Missouri ore, with gold predominating. The property is owned by Buena Vista Mining, 53 per cent of the stock of which is held by Consolidated and the remainder by Big Missouri. Development work done includes 8,000 ft. of diamond drilling and 3,000 ft. of crosscutting and drifting. Construction of a motor road to connect with the Premier-Stewart road has been completed.

■

Vanadium Corp. Builds Plant at Virginia Ilmenite Mine

Construction of a plant for the production of titanium at the ilmenite mine of the Vanadium Corporation, in Amherst County, Va., is now being undertaken by Stone & Webster, Inc. The plant is expected to start operations in October. Officials of the Vanadium Corporation are not prepared at present to give figures on tonnages, as the first unit will act as a pilot to determine the scale of operations in the future.

■

Seneca Hopes to Reach Capacity Next Year

Development at Seneca Copper is progressing favorably, and this Michigan copper producer may be in a position to utilize the full capacity of its surface plant early in 1931, provided the copper market turns upward. All four stamps in the Lake No. 2 mill at Hubbell, which treats Seneca ore, will then be needed, for capacity is 2,600 tons daily. If Seneca builds its own mill, the plant probably will be erected near the mine to save transportation cost. Adaption of the flotation process to Michigan ores obviates the necessity for the tremendous water supplies needed in gravity concentration and permits building plants inland.

Seneca is now deepening its No. 1 shaft two levels at a time. The shaft is now being put down to No. 13 level, 100 ft. having been sunk during June. A station at the No. 12 level will be cut later. No. 11 level has opened up well to the north, and the company entertains hopes that ore will continue at depth. At No. 2 shaft, which has been stripped down to the No. 25 level, connecting with No. 3 level from No. 1 shaft, a station is being cut on the No. 21 level and preparations are being made to start the No. 22 level.

Bullion Chief Starts Work on Mill at Maxfield

Erection of a 45-ton milling plant has been started at the Maxfield mine, Big Cottonwood Canyon, Utah, by Bullion Chief Mining. Gravity concentration, supplemented by flotation of the slime, will be used. The mill will be operated in closed circuit and tailing piled, so as not to pollute Big Cottonwood water, an important source of supply for Salt Lake. Ore, assaying 7 per cent lead, 11 oz. silver and $1 in gold to the ton, surrounds the old stopes, productive in the past of about $3,000,000, according to Lloyd Hoskins, manager of the company. The company is putting up a two-compartment raise from the main tunnel at a point 1,000 ft. from the portal. It will connect with No. 1 stope. A Denver Rock Drill rotary stoper was recently purchased for this work.

■

Fire in Glenn Placer Mine Kills Five Men

Fire of undetermined origin which started at 10:30 p.m., July 4, at the Glenn placer mine, Robertson's Flat, above Forest Hill, in Placer County, Calif., destroyed the entire surface equipment and, getting out of control, spread to the surrounding forest. It was still burning on July 16. Five men were trapped in the mine and died of monoxide poisoning. They were James Campini, Sly Park, foreman and part owner; Tom Capitani, Forest Hill; Joseph Scherer, Roseville; George Henry, Yuba City; and E. L. Shepherd, Grass Valley. Two men escaped from the mine. Mine rescue crews from the Empire mine, at Grass Valley, responded to the call, but arrived too late to be of assistance.

■

Butte First-Aid Contest Won by Anselmo-Mine Team

Before a record crowd of 20,000, the first-aid team from the Anselmo mine of Anaconda Copper won the annual first-aid contest held on Butte field day, July 15, at the Columbia Gardens in Butte, Mont. The team received a rating of 590, compared with 586 for the Leonard mine first-aid team, which took second place. The first-aid team of the Tramway mine took first place in the Class B event, with a rating of 574. The men who composed the winning Anselmo team were Hanford Estabrook, Louis Bertoglio, John Langhorn, Theodore Morel, Joseph Stevens, Charles Monaghan, and Bernard Noon. Inar Norgaarz, of the Badger mine, won the shoveling contest in 1 min. 53 sec., compared with 1 min. 54 sec. for John Espelund, last year's winner.

■

Sale of Oregon Crater Stock Under Investigation

As a result of investigation into the Oregon Crater Corporation, owning land on Bald Mountain, south of Baker, Ore., Mathew A. Tiffany, deputy attorney general of the New York State Bureau of Securities, has had further dealing in the stock by the promoters prevented, through an enjoinment by Supreme Court Justice B. J. Humphrey. McAdow & Company, brokers, of New York City; R. B. Keizur, president of the mining company; A. M. Richardson; and C. E. McAdow, of the brokerage firm, were enjoined. Mr. Tiffany charged that no effort had been made to develop the property, although 200,000 shares of stock were sold at prices of 35c. to 75c. a share. Promotional literature is alleged to have predicted "phenomenal production of gold, silver, and quicksilver."

■

A. S. & R. Acquires Interest in Mining Trust

American Smelting & Refining, largest smelter and refiner of non-ferrous metals in the world, has acquired a "substantial interest" in Mining Trust, according to official announcement on July 21. In addition, A. S. & R. has made an agreement to furnish Mining Trust with technical advice for ten years in the management and administration of mining properties and smelting and refining plants. Through this transactions, the "necessary capital for further development and equipment of Mount Isa on an extended scale and also for the construction of a silver-lead bullion refinery" has been provided, Leslie Urquhart, chairman of Mining Trust, stated in London.

Mount Isa, which is probably the most important of the Mining Trust subsidiaries and also the largest silver-lead-zinc deposit in the world, is now being equipped for production of 2,000 tons of ore daily. Construction of a concentrator and smelter at the property in Queensland, Australia, has almost been completed. These plants have been designed to permit enlarging to a capacity of 5,000 tons of ore daily, and eventually to 10,000 tons daily. Ore reserves were estimated at 28,000,000 tons in the last progress report of Mining Trust, but they are expected to be greatly increased. Participation of A. S. & R. indicates increasing mill capacity and construction of an electrolytic zinc plant will be possible at a date earlier than had been anticipated. Output of Mount Isa at the initiation of operations will be at the rate of about 70,000 tons of lead annually.

In addition to Mount Isa, Mining Trust has under development very large holdings in the Bulolo River gold field of New Guinea, through New Guinea Goldfields; an extensive lead-zinc concession in Queensland, known as Lawn Hills; a producing lead-zinc property in France, Compagnie Nouvelle des Mines de Villemagne; and Mining Trust of Northern Rhodesia, which is exploring a large concession with copper possibilities.

A. S. & R. recently raised $20,000,000 through the issue of additional preferred stock. These are probably the funds that are being used for investment in Mining Trust. The company is responsible for the smelting and refining of about one-third of the world's total production of silver, copper, and lead. In addition, it owns, or has a controlling interest in, mines in Mexico, Canada, Peru, Newfoundland, and the United States.

■

C. M. & S. Gets Rights in Africa

Consolidated Mining & Smelting, largest Canadian producer of silver, lead, and zinc, has obtained exclusive prospecting rights over a large area in British South West Africa. Some tin, copper, gold, and diamonds are produced from the colony at present.

Base Metals Recovery High and Costs Kept Low

Operation of the 300-ton concentrator of Base Metals, at Field, B. C., during the month of June showed remarkable recoveries for a complex lead-zinc ore, according to a statement prepared by George Wingfield, president of Goldfield Exploration, which controls the Base Metals property. The mill handled 7,873 tons of ore, despite a shutdown for two days during the month, occasioned by holidays. The average grade was 8.3 per cent lead, 12.7 per cent zinc, and 3 oz. of silver to the ton. Loss in tailing was only 0.5 per cent lead and 1.9 per cent zinc, indicating a recovery of 94 per cent of the lead content and 86 per cent of the zinc content. Net returns were 2.3c. per pound of lead and 1.5c. per pound of zinc. Despite these low prices, the company made an operating profit of $17,290. Gross income was $39,643 and expenses were $22,353, or less than $3 per ton of ore milled.

■

Golconda to Continue Drift Into Square Deal Area

Development of the adjoining Square Deal property, which it has under option, will be carried on through a drift from the 1,400 level of its own mine, near Wallace, Idaho, by Golconda Lead. On this level the drift has been driven along the Golconda orebody for 800 ft. and is now about 600 ft. from the Square Deal boundary. It will be continued along the vein and should be completed to the boundary by the end of the year. Under the terms of the option, the Golconda company will have to do $15,000 worth of development each year for five years on the Square Deal property.

No ore has yet been developed in previous work, but the Golconda drift will cut the property 1,300 ft. below the Square Deal tunnel, and hope is held that silver-lead orebodies similar to those opened up in the Golconda will be found at that depth.

■

Aladdin Prepares to Produce Gold From Rising Hope

Aladdin Gold Mining, operating the old Rising Hope drift mine, 3 miles east of Placerville, Calif., has developed 100,000 cu.yd. of $4 gravel. The gravel is opened by 10,000 ft. of drift tunnels, 12 ft. below the bottom of the channel, and seven faces are prepared for mining. Haulage is by storage-battery locomotive. The pay gravel is 6 ft. thick. It will be washed in a plant having a capacity of 450 cu.yd. a day. Clyde E. Collins is superintendent at the mine for the company.

■

Report Find on Altar & Cananea

Operations on the 200 level of the Copper Prince mine of Altar & Cananea Mining, near Altar, Sonora, have struck high-grade copper ore, according to George Young, managing director of the company. The ore has been cut for 18 ft. About 15 men are working on the Cobre group of the company, of which the Copper Prince is the most important working, and about 10 men are employed at the Clara, one of the two other groups that the company owns near Altar. O. H. Weaver is in charge of this work.

Drop in Metal Prices Creates Activity at Small Nevada Gold Mines

WITH base-metal prices, to say nothing of silver, at much the lowest levels reached since the War, miners in Nevada have turned their attention to gold. The number of prospectors in the hills is said to be the largest in years, although no sensational discoveries have yet been made. Within the last year, however, about ten plants for treating gold ore, most of them small, have been started in Nevada, and six more are now under construction.

Of the plants that have started, the largest is the 200-ton cyanide installation of Seven Troughs Gold Mines, at Lovelock, which has just reached capacity operation. Crushing was started on June 26. About 1,000 tons of ore was needed to load the solutions. For this purpose, ore running about $4 a ton was used. The plant was shut down for three days on July 4, but since July 6 it has been running steadily, with some minor readjustments. The mill has indicated that it can exceed its rated capacity by a considerable tonnage. Grinding capacity has been demonstrated as 160 tons per shift, or 480 tons daily. Only two men per shift are required for this section.

Seven Troughs will make its first cleanup on Aug. 6, and thereafter a cleanup will be made about once every two weeks. At present ore is being drawn from the 5,100 vein, so named because it was cut 5,100 ft. from the portal of the main tunnel, now in a total of 11,834 ft. Seventeen raises have been put up on this vein. along a length of 900 ft. A winze has been put down 230 ft., and the fourth station is now being cut. Official statement has been made that ore in the bottom of the winze averages $49 per ton. Samples from 793 mine cars drawn from the stopes as development progressed are said to have averaged $37.10 per ton.

Of the present monthly production of about $70,000 of Tonopah Extension, between $25,000 and $30,000 is gold. The ratio of gold content of the ore has not increased, but the drop in the price of silver has made the proportion of its value higher.

In the Cherry Creek district, north of Ely, Standard Mines started its new 50-ton mill about a month ago. At first company ore was treated, but the plant is now handling about 700 tons of ore broken during development of the Alto Divide lease. Another 50-ton plant to start within the last month is the amalgamation mill of New Pass Gold Mining, a few miles west of Austin. The ore carries free-milling gold. In Telephone Canyon, southeast of Mina, on property owned by O. J. Bellville, a 15-ton Ellis mill has been started. The claims are at an elevation of 8,000 ft. and high-grade ore was formerly shipped on burros. A road has now been built to the property. Another 15-ton Ellis mill is being operated by the three Manker brothers in the Olinghouse district, once famous for its high-grade ore. A narrow streak of high-grade ore has been opened up, with a larger tonnage of comparatively low-grade material in sight. The old 50-ton amalgamation plant, in the same district, has been started up again and is operating on ore from several properties.

At Olinghouse, Chris Larson has opened a gold orebody by his own efforts and also operates an old-style arasta, run by a 3-hp. gasoline engine. He works entirely alone and is credited with having said, "What's the use of hurrying or worrying over the drop in price of silver, copper, lead, and zinc? Gold is the same old price, and when I need a little more money, the oreshoot is there and I go in and take some out. I can easily make from $1,500 to $2,000 a year. What more do I want?"

Among the gold mills under construction in Nevada, probably the most important is the 100-ton cyanide plant of Gold Hill Development, 3 miles from Round Mountain. Operations are expected to start about Aug. 1, under the direction of H. A. Johnson, general manager of the company. To indicate the speed with which construction of the plant is being pushed; on July 6 a carload of machinery from the Joshua Hendy Iron Works arrived at Tonopah. The main unit of the ball mill, weighing eleven tons, was unloaded first. It was mounted on a 15-ton truck and was on its way to Round Mountain within four hours of the arrival of the train. The remainder of the shipment, on smaller trucks, went straight through to the property without the usual overnight stop at Manhattan. The equipment arrived soon after midnight, was unloaded at daybreak, and placed in position before noon. In addition to Gold Hill Development ore, the plant will handle material from Gold Zone, an adjoining property, now sinking a two-compartment shaft. Round Mountain Mining has an abundant water supply for its placer property in the same area and results are said to be better than in several years.

Kernick Divide is building a 50-ton mill at Sodaville to mill ore from its property, 4 miles distant in Gold Gulch. The mill will also handle custom ore from small properties in the same district. At the Shang mine, a 30-ton mill, formerly used at Seven Troughs, is being installed by Argyle Mining. G. B. Hartley, president of the company, is also adding fifteen stamps to the mill on his property near Nevada City, Calif., now equipped with five stamps.

Ohio Mines has ordered machinery for a 100-ton mill at its gold properties near Hornsilver. R. H. Rowland and C. E. Warmouth have just completed construction of a 25-ton Ellis mill at the old Auburn mine, 18 miles southeast of Winnemucca, which will start as soon as a 2-mile water line has been completed. A 25-ton amalgamation plant has been hauled from the Buckaroo mine, northern Humboldt County, to the Yellowstone property, 30 miles from Winnemucca, and is now ready to run.

Two mills are planned for the Rochester district—one by G. A. Smith and Belle McCord Roberts, of Long Beach, Calif., who have taken over the Hildebrant-Hohn property; and the other by Utah Rare Metals at the Walker mine, near Limerick Canyon. Both properties carry gold.

■ ■ ■

Ontario Mining Men Form Safety Organization

The Ontario Mining Association, at its annual meeting, held recently in Sudbury, decided to form an Accident Prevention Association. This action was taken as a result of the growing activities of the Compensation Committee of the association. The meeting to consider the question was attended by representatives of nearly all the mining companies and also by the representatives of several manufacturing groups. A provisional board of directors was appointed and the necessary steps will be taken to incorporate the association.

Officers for the ensuing year were elected as follows: President, H. P. De Pencier, Dome Mines, South Porcupine; first vice-president, D. L. H. Forbes, Teck-Hughes Kirkland Lake; second vice-president, F. D. Reid, Coniagas Mines, Toronto; executive committee, J. P. Bickell, J. Y. Murdock, J. L. Agnew, J. P. Watson, and F. D. Reid; and G. C. Bateman, secretary-treasurer.

■

Expect to Resume Big Hill Development This Month

Sinking of the three-compartment shaft at the Big Hill property, in the Tintic district, of Utah, will be resumed at the end of this month, provided North Lily stockholders ratify the acquisition of the Knight Investment Company's Tintic district holdings. A meeting to consider the proposal has been called by J. O. Elton, president of North Lily, for July 25. If it goes through, as seems likely, $300,000 will be provided for development of the Big Hill, Twentieth Century, Empire Mines, and other Knight properties, by North Lily, which is controlled by International Smelting, Anaconda Copper's Utah subsidiary.

The Big Hill shaft is now bottomed at 860 ft. It will be put down to the Ophir formation and will be used as a center from which some of the most strongly mineralized surface showings in the East Tintic district will be explored.

■

Drills Double Ore Reserves at Abana in Four Months

Drilling on the property of Abana Mines increased the ore reserves from 477,200 tons on Feb. 1 to 937,900 tons on June 1. according to a report by H. E. Clement, general manager of the mine, in the Rouyn district of Quebec. Of the total reserves, 399,500 tons is copper ore, of an average value of about 4.7 per cent copper, 7 per cent zinc, 4 oz. of silver, and 0.5 oz. of gold to the ton. The remainder is zinc ore, averaging about 18 per cent zinc, 0.80 per cent copper, 4 oz. of silver, and 0.03 oz. of gold to the ton.

Mill construction is being pushed and is limited only by the lack of sleeping facilities at the camp. The plant will handle 250 tons daily, but may be increased to 500 tons, depending on corroboration of drill results by actual development and improvement of market conditions to permit handing zinc ore at a reasonable profit. About 110 men are now employed underground, on mill construction, and on the road to Dupuy.

A meeting of the board of directors of Abana was held in Montreal on July 15, at which one of the large shareholders advanced $40,000 to permit completion of payments for the property.

EXCLUSIVE

CABLES

FROM CORRESPONDENTS IN THE PRINCIPAL MINING CENTERS

Union Minière Output Is Higher Than in 1929

London, July 18.—Commenting on present conditions at the annual meeting of Union Minière du Haut-Katanga, Jean Jadot, president of the company, declared himself to be well satisfied with prospects. The present low price of copper leaves a good margin of profit, he said, and the company's net copper surplus is equal to about two months' output. During 1929 the company mined 2,225,000 tons of ore. Nevertheless, the ore reserves, which were estimated at the end of 1928 as 78,000,000 tons, have been increased slightly. Copper production in 1929 was 136,992 metric tons, compared with 112,456 in 1928, which was the previous high record. Union Minière is now the world's largest copper producer. Copper production during the first six months of 1930 was 65,000 tons, compared with 63,000 tons for the corresponding period of 1929. Grade during 1929 averaged about 6.5 per cent copper. Radium sales during 1929 were 60 grams, compared with 42 grams sold in 1928; and cobalt sales increased from 450 tons in 1928 to 700 tons in 1929. The company declared a dividend of 300 francs, the same as the payment in 1928.

. . . . A feature of interest in the report is the statement that a geological inspection of southeastern Katanga justifies the belief that deep deposits exist there similar to those across the line in Northern Rhodesia. The company has acquired property in this section for further exploration. This move is of particular interest, since the Rhodesian deposits were found in searching for extensions of the Katanga orebodies. At that time, the comparatively low grade of the Rhodesian deposits discouraged search, but since then central Africa has made such strides that 8 or 9 per cent ore is no longer considered necessary for profitable operation.

. . . . Union Minière is now making arrangement for the reopening of the Western or Musonoi group of mines, in which large reserves have been proved but which have not been worked for several years, as the Central and Eastern groups have been able to supply the existing smelting capacity. A further increase in capacity for the company is therefore foreshadowed. Native employees of Union Minière now number 17,000, an increase of 1,800 during the last year. Both in the Belgian Congo and in Rhodesia the labor situation is steadily improving. At the meeting, M. Jadot also made clear the extent of his company's holdings in Hirsch Copper & Brass, operating copper refineries in Germany. They total 18 per cent, or about one-sixth of the issued capital.

. . . . June figures for production from Northern Rhodesia's two operating base-metal enterprises have been made available. Bwana M'Kubwa put out 560 short tons of copper, which is slightly below its average, and Rhodesian Broken Hill development produced 1,632 long tons of electrolytic zinc, indicating the company is in a position to produce 20,000 tons annually, or better than the rated capacity of its plant.

. . . . Borehole No. 13 on the Roan Antelope Extension has cut four separate orebodies, with the following results, beginning at 1,105 ft.: 17.5 ft. of 3.25 per cent copper; 18.5 ft. of 4.12 per cent copper; 13.3 ft. of 2.59 per cent copper; and 17.8 ft. of 2.18 per cent copper. The last orebody was entered at a depth of 1,356 ft. Borehole No. 21A at Mufulira has struck all three orebodies, beginning at 2,000 ft. They showed 26.3 ft. of 5.28 per cent copper; 36.2 ft. of 4.34 per cent copper; and 41 ft. of 2.64 per cent copper.

■

Chilean Nitrate Consolidation Approved by Government

London, July 18.—The Chilean Congress has approved the formation of the Compañia Salitrera Nacional, or Cosana, as it is now known, whereby the entire nitrate industry will be consolidated into one organization, with a capitalization of £75,000,000. Chilean production for the fiscal year 1929-1930, which ended on June 30, is given as 30,000,000 quintals (3,000,000 tons), whereas exports were only 22,000,000 quintals. The July selling price for nitrate in Great Britain and Ireland is unchanged from the June price. Eventually, the elimination of the export tax, which is one of the chief objects of the consolidation, will permit lowering of the price.

. . . . According to the government's announcement, 28 companies, representing 91 per cent of the productive capacity of the nitrate industry, have signified their approval of the consolidation, and will cede their nitrate holdings to the new company in return for stock. The Chilean government will retain 50 per cent of the capital in lieu of the export tax, formerly its chief source of revenue. Among the companies behind the consolidation is Anglo-Chilean Consolidated Nitrate.

. . . . Efforts are still being made to assist the tin industry. The bulk of opinion favors restriction, although some low-cost producers believe that the principle of hampering the strong to protect the weak is wrong and that high-cost units should be entirely eliminated. Apparently the Malayan government will not help, because its revenue is derived mainly from tin and rubber production, and both are depressed.

. . . . At the annual meeting of Tronoh Mines on July 16, the chairman, C. V. Thomas, said the company had agreed to the policy of shutting down for two months. At present prices this large producer has been barely able to make both ends meet. Mr. Thomas pointed out that a shutdown of two months would still enable the company to review the position at the end of the first month, and, if sufficient improvement were noticeable, to start operating again. Several other companies have agreed to stop producing to reduce current supplies. Figures of stocks on hand are still believed to be unreliable by many observers of the market. Estimates have been made that £3,500,000 is locked up in tin stocks in London, the exact amount being impossible to ascertain because of the violent fluctuations in price. The Nigerian Chamber of Mines has backed the plan of the Tin Producers' Association.

. . . . Mexico Mines of El Oro, one of the most profitable British mining enterprises in Mexican silver mines, has finally been liquidated. Shareholders have been given eight shares in the Companhia Agricola Florestal, operating in Brazil, for every five shares of Mexico Mines stock held. The Brazilian company is engaged principally in coffee production and its stock was completely held by Mexico Mines.

. . . . Trepca Mines, the Jugoslavian lead-zinc enterprise, is issuing 500,000 new shares of 5s. par to complete equipment of its Stantrg mine. This company, controlled by the Chester Beatty interests through Selection Trust, already has an issued capital of 4,000,000 shares of 5s. par.

■

Heavy Water Flow Struck in East Geduld Shaft Sinking

Johannesburg, July 16.—Directors of East Geduld, which promises to be the next large new gold producer on the Witwatersrand, have announced that the main shaft has now passed through the dolomite formation, which ended at a depth of 1,027 ft. A permanent pumping plant for dealing with the water encountered during shaft sinking is being installed. After completion of these arrangements, a more rapid sinking rate will be possible. The water flow is about 2,000,000 gal. daily, or about 1,500 g.p.m. The shaft is expected to cut the main reef at a depth of 2,850 ft. and the remaining 1,800 ft. will probably be sunk in about nine months.

. . . . Construction of the East Geduld reduction plant, which will have a capacity of 60,000 tons of gold ore daily, is making satisfactory progress. Provided the work remaining to bring the mine into the producing stages continues in accordance with present expectations, East Geduld should start production within twelve months. Development headings have been driven into the property from the adjoining Geduld Proprietary mine, so that comparatively little time will be needed to put the mine in preparation for stoping once the shaft has cut the reef.

. . . . As a result of satisfactory progress at both East Geduld and Daggafontein, the other large potential producer on the Far East Rand now under development, increasing interest is being taken in Witpoort Gold Areas. This property has not reached quite the advanced stage of either East Geduld or Daggafontein, but continuity of the reef has been proved and development is being actively pushed at all available points.

MARKET AND FINANCIAL NEWS

Belgian Restriction May Help Zinc Industry

INTERNATIONAL METAL SERVICE, LTD., LONDON

To all outward seeming, June did little toward putting zinc on a sound footing again; though there is at least hope that some constructive progress is being made, in the announcement that Belgian smelters have brought a substantial cut in output into force from June 1. The rate at individual smelters is said to range from 10 to 50 per cent, and the general average to be about 22½ per cent. There does not appear to be any doubt as to the accuracy of this report, which is really the best piece of news which has come to hand for many a long day.

It is, of course, a tragedy that increased production, coupled with a decline in consumption, has made such a step necessary; and it is equally to be regretted that the curtailment could not have been shared equally by the whole of those producers who supply the European market, but apparently agreement was not possible. There is no gainsaying the fact that the "cut" was very much overdue, and that up to a short time ago production was decidedly in excess of demand.

Whether the action of the Belgian smelters by themselves will serve to redress the balance, time alone will show. Frankly, we do not think it will, and there is warrant for the conclusion that, failing a quick recovery in consumptive demand, it will be necessary for other countries to fall into line and trim their output. As for the first of these two alternatives, much as it is to be regretted, there is little or no prospect of any immediate improvement in demand. It is rather like flogging a dead horse to have to keep on with the story of a poor export demand for galvanized sheets, but, poor it is, and until the unrest in India is past, and the adverse exchanges in Australia and South America are rectified, there is not much hope of British export demand enlarging to any noticeable extent. It is not only our own galvanizers who are suffering: Germany sends reports of poor activity in this industry, and, as for the United States, trade there seems to be almost as hard hit as in Europe.

Reports from the rollers of zinc sheets are also the reverse of encouraging; indeed, the only news not of a gloomy nature comes from some of the Continental brass works, which are now operating at a better rate than in April or May—although not up to last year's scale.

Some stability has also been afforded the market by the news that Russia has bought 4,000 tons or so of zinc from Poland, for delivery between now and the end of August, but this statement is rather too ambiguous to have much effect; though it should of course mean that there ought not to be much selling pressure from that quarter for a while.

As far as the proposed tariff on imports into Germany is concerned, it looks as though this is dead; though as the announcement says only that the question has been postponed until the autumn, it does give the German producers a period of grace in which to try to overcome the objections raised on all sides to this tariff. Anyway, for the time being the idea is shelved, and those producers who have hitherto found a good market in Germany for at least some of their output can breathe freely again.

The extent to which the production of High-Grade zinc is cutting into the business in ordinary or Prime Western metal is perhaps best exemplified by its growing output. During 1927 world production of electrolytic zinc totaled 229,700 metric tons. This went ahead to 299,200 metric tons in 1928, and made a further advance in 1929 to 327,100 metric tons. Equally certain is it, too, that there will be another gain in 1930, because new plants are under construction in Canada, Germany, and Poland, in addition to which additions are being made to the Tasmanian works.

It is certain that the shoe is pinching some of the High-Grade producers. Where they are running on ores from their own mines, profits are badly down on the year and there is an increasing difficulty in placing all the metal produced. This difficulty has not been lightened, as far as Europe is concerned, by the fact that the latest comer to the ranks of electrolytic zinc producers has, so far, not seen fit to fall in line with the others and ask a premium of £2 per long ton over G.O.B. brands. Production in June in metric tons:

United States	99,400
Canada, including afloat	7,100
Germany-Poland	18,200
Belgium	11,500
France	2,800
Great Britain	8,600
Other Europe	3,500
Australia, including afloat	13,000
Far East	2,000
Elsewhere	2,000
Total	168,100

This represents a gain of 19,900 metric tons during June.

Increase in Daily Rate of World Copper Output

Figures for world copper production in June, released by the American Bureau of Metal Statistics, show a drop in the total output, compared with May, but an increase in the daily rate, because of the shorter month. Total production is put at 145,556 tons, compared with 148,788 in May, and the daily average is estimated at 4,852 tons, compared with 4,800. A sharp increase in Canada's production probably reflects the approaching completion of International Nickel's Frood expansion program. The figures in parentheses are those for May in the following tabulation of the more important countries: United States, 69,155 (75,936); Mexico, 5,371 (5,262); Canada, 11,005 (8,782); Chile and Peru, 23,043 (22,213); Japan, 7,895 (7,412); and Europe, 15,300 (17,236). The average daily rate of production to date in 1929 is 4,888 tons, compared with 5,853 tons in 1929 and 5,236 tons in 1928. Average monthly production for 1930 is 147,469 tons, indicating that the drop in the price has not yet curtailed output much compared with the rate prevailing in the last few months of the 18c.-copper period. Daily rate of production in January was 5,027 tons, which is only 175 tons more than the current rate.

Refined copper production, shipments, and stocks, North and South America, in tons of 2,000 lb., follow:

	April	May	June
Production:			
Primary	113,758	122,259	117,576
Scrap	10,773	9,924	7,245
Total	124,531	132,183	124,821
Daily rate	4,151	4,264	4,161
Shipments:			
Domestic	50,017	75,760	71,887
Export	29,196	49,115	44,818
Total	79,213	124,875	116,705
Stock, end of month	301,338	308,646	316,762

■

Quincy Shows Large Loss

Operations of Quincy Mining, in the Michigan copper district, resulted in an operating loss of $1,216,661 in 1929, before depreciation or depletion. The fact that the company operated largely on a development basis accounts for the size of the loss. Production of copper was 4,459,426 lb., sold at an average price of 18.28c. a pound. In 1928 the company made an operating loss of $875,279. Production for the first five months of 1929 was 4,203,000 lb. and is increasing.

Mining Company Dividends for July, 1930

Companies in the United States	Situation	Per Share	Total Disbursements
Aluminum Company of America, pfd	Various	$1.50 Q	$2,214,930
American Zinc, Lead & Smelting, pfd	Various	1.50 Q	120,590
Bunker Hill & Sullivan, l. s	Idaho	0.50 MX	245,250
Bunker Hill & Sullivan, pfd	Idaho	1.50 Q	11,485
Copper Range, c	Michigan	0.25 Q	98,673
Cresson Consolidated, g	Colorado	0.02 Q	24,000
Eagle-Picher Lead, pfd., l. z	Oklahoma, Missouri	1.50 Q	12,770
Homestake Mining, g	S. Dakota	0.50 M	125,580
Inspiration Consolidated Copper	Arizona	0.50 Q	590,988
Kennecott Copper	Various	0.75 Q	7,029,092
Magma Copper	Arizona	1.00 Q	408,154
Newmont Mining, h	Various	1.00 Q	452,760
Nichols Copper "A"	Various	0.4375 Q	40,247
Phelps Dodge, c	Various	0.75 Q	1,500,000
Silver King Coalition, s. l. z	Utah	0.25 Q	305,116
St. Mary's Mineral Land, c	Michigan	1.00	160,000
*Tennessee Copper & Chem	Tennessee	0.25 Q	198,656
U. S. Smelting, Refining & Mining	Various	0.25 Q	121,587
U. S. Smelting, Refining & Mining, pfd	Various	0.875 Q	425,557
Companies in Other Countries			
Consolidated M. & S., l., z., s	Canada	6.25 SAB	3,185,837
Dome Mines, g	Canada	0.25 Q	238,333
Greene Cananea, c. s. g	Mexico	0.75 Q	375,000
Hollinger Consolidated Gold	Canada	0.05 M	246,000
Howe Sound, c. l. z	Mexico, Canada	1.00 Q	496,038
N. Y. & Honduras Rosario, g. s	Honduras	0.25 Q	50,000
Nipissing, s	Canada	0.075 Q	90,000
Noranda Mining, c. g	Canada	0.50 Q	1,119,500
Premier Gold, s. g	Canada	0.06 Q	300,000
Total			$20,186,143

c, copper; s, silver; l, lead; z, zinc; g, gold; h, holding; Q, quarterly; M, monthly; X, extra; SAB, semi-annual $1.25, plus $5.00 bonus; * paid in June, omitted from our last list.

Holding Companies Purchase Bulolo Dredging Shares

A group of interests consisting of the Gold Fields American Development Company, Ltd. (New York subsidiary of Consolidated Gold Fields of South Africa, Ltd.), International Mining Corporation, and Pardners Mines Corporation have purchased a large part of the share capital of Bulolo Gold Dredging, which is now equipping a placer area in New Guinea. The property now owned by Bulolo Gold Dredging, which is on the Bulolo River, was prospected and drilled by the Placer Development Company, Ltd., and sold to Bulolo Gold Dredging for a share interest in that company. Placer Development is now drilling another property on the Bulolo River and has several other holdings in various parts of New Guinea.

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Control of Trout Mining Now Held by American Machine

Announcement is made that American Machine & Metals, Inc., has succeeded to the business of the Manhattan Electrical Supply Company, Inc., including control of the Trout Mining Company, of New Jersey, which operates manganese and silver-lead-zinc properties at Phillipsburg, Mont. The company also controls U. S. Manganese Corporation, with properties in Virginia. C. K. Woodbridge, of the brokerage firm of Prince & Whiteley, has been elected president of American Machine & Metal.

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C. M. & S. Output Increases Despite Low Prices

Consolidated Mining & Smelting Company of Canada, a subsidiary of the Canadian Pacific Railway, reports increased production, both for second quarter of 1930 and first half year, from its mining and metallurgical operations in British Columbia. Figures for the quarter, with comparisons, follow:

	1930	1929
Lead, tons	36,568	38,594
Zinc, tons	27,349	22,783
Copper, tons	2,547	32
Gold, oz.	7,790	3,040
Silver, oz.	1,553,946	1,495,424
Six months:		
Lead, tons	75,528	71,665
Zinc, tons	57,202	45,467
Copper, tons	5,889	710
Gold, oz.	11,860	8,568

■

Arsenic Stocks Down

Production of crude arsenic in May amounted to 1,652 tons, according to the American Bureau of Metal Statistics, and production of refined arsenic amounted to 963 tons. Deliveries of crude arsenic direct to consumers amounted to 633 tons. Corresponding figures for April were 1,550 tons, 1,084 tons, and 312 tons. Crude stocks at the end of May were 3,935 tons, compared with 4,159 tons at the end of April, and refined stocks were 2,726 tons, compared with 2,889 tons.

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NORTH BUTTE MINING, operating copper properties in Montana, is issuing 500,000 shares of stock at $2.50 a share to stockholders, who may subscribe for up to 50 per cent of present holdings. The offer expires Aug. 1.

MCINTYRE PORCUPINE MINES, operating a gold property in Ontario, had a gross income of $1,148,866 in the quarter ended June 30, compared with $1,062,611 in the corresponding quarter of 1929. Net earnings, after providing for taxes but not for depreciation, were $484,035, compared with $441,180.

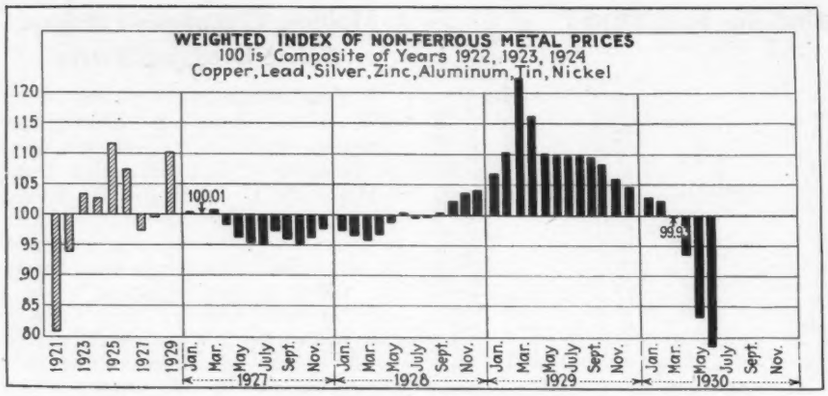
New York Mining Exchange

Active trading of mining securities is expected to begin on the New York Mining Exchange by Sept. 10. The exchange corporation has established permanent executive offices in New York in the Munson Building, at 67 Wall St., according to a recent announcement. The New York Mining Exchange was organized in January of this year under a charter of the State of New York for the purpose of providing a central market for securities of established companies engaged in mining, oil, and allied industries, especially many of those stocks now listed and traded on the various exchanges of the United States, Canada, and other countries.

RAWANG TIN FIELDS, operating in the Federated Malay States, made a net profit of £44,399 in 1929. The company's issued capital is £876,000 in 10s. shares.

Complete Market News and Prices

THE semi-monthly magazine you are now reading carries only a condensed review of important market news and price movements. For buyers and sellers of ores, metals, minerals, and scrap who require reliable information as soon as it is available, we now provide *Metal and Mineral Markets*, which goes to press at the close of the metal-market week each Wednesday. It is printed at high speed and is in the mails that evening. In compact form, ready for insertion in a ring binder, it is ideal for desk and reference use. It carries the standard *E.&M.J.* quotations used in contracts the world over, recognized as authoritative and dependable. *Metal and Mineral Markets* is priced to subscribers in the United States and its possessions at $2 per annum; to countries in the Americas but outside the United States, $5; elsewhere, $10 yearly: 52 issues. Address *M.& M.M.*, 36th St. and 10th Ave., N.Y.City.



Index figures for 1930 are: January, 102.94; February, 102.28; March, 99.93; April, 93.24; May, 83.41; and June, 78.57.

U. S. Quicksilver Output Rose in 1929

Production of quicksilver in the United States in 1929 amounted to 23,682 flasks of 76 lb. each, according to the U. S. Bureau of Mines. The calculated value is $2,892,638. This is the largest domestic production since 1918, when 32,450 flasks was produced, but is only about 73 per cent of the average annual production from 1850 to 1921, inclusive. The incentive to produce was greater in 1929 than during the period 1850 to 1921, as the average quoted price was approximately $122 a flask, compared with $48 a flask for the period 1850 to 1921. The production of quicksilver in 1928 was 17,870 flasks of 76 lb. each, having a calculated value of $2,207,003.

California again led the mercury-producing states with an output of 10,139 flasks, Nevada was second with 4,764 flasks, followed by Oregon with 3,657 flasks. The State of Washington produced 1,397 flasks, and Texas, Arizona, and Alaska, together, 3,725 flasks. In addition, 171 flasks of mercury were produced in Nevada from gold and silver pan-amalgamation tailing. In 1928 the production, by states, was as follows: California, 6,977 flasks; Nevada, 2,867 flasks; Oregon, 3,710 flasks; and Texas, Washington, and Arizona, together, 4,316 flasks. Secondary mercury from pan-amalgamation tailings in Idaho and Nevada in 1928 amounted to 414 flasks.

In 1929, 14,292 flasks, valued at $1,447,142, were imported, compared with 15,378 flasks, valued at $1,572,017, in 1928.

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Magnesite Industry in 1929

The total quantity of crude magnesite mined in the United States in 1929 was 187,660 short tons, with an approximate value of $1,500,000, according to reports furnished by producers to the U. S. Bureau of Mines. This is the largest quantity mined since 1920 and is an increase of 47.5 per cent over 1928 output of 127,200 short tons. There were four operators in California, working four mines, one each in San Benito, Santa Clara, Stanislaus, and Tulare counties, and one operator at Chewelah, Stevens County, Wash.

Imports of crude magnesite in 1929, according to the Bureau of Foreign and Domestic Commerce, were 300 short tons crude, valued at $3,179; 6,500 short tons caustic calcined, valued at $145,874; and 46,382 short tons dead-burned, valued at $670,166.

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ALASKA JUNEAU mined and trammed to mill 316,770 tons in June, from which estimated results were $265,500, or 83.81c. per ton. Operating expenditures were $169,000, or 53.35c. per ton; and operating profit was $96,500, or 30.46c. per ton. Other expenditures and accrued charges totaled $13,400, leaving to surplus $83,100 for the month. Indebtedness was reduced by $93,425.23, leaving an unpaid balance of $520,000.

Domestic Lead Output Dropped in June

Production of lead in the United States from domestic and foreign ore, as well as secondary metal handled by primary smelters, dropped from 59,170 tons in May to 55,686 tons in June. Output from domestic ore was 50,721 tons last month, or a daily rate of 1,691 tons, compared with 52,818 tons, or a daily rate of 1,704 tons, in May. Stocks of the metal increased from 49,638 tons at the begnining of June to 55,501 tons at the end of the month, indicating shipments of 49,823 tons. Actual shipments reported were 50,127 tons. Shipments by difference in May were 51,547 tons and actually reported, 51,871 tons.

Average monthly production of lead from domestic ore has been 53,292 tons so far in 1930. In the corresponding period of 1929, average monthly production was 59,979 tons. Last June, domestic production was 58,380 tons, compared with this month's total of 50,721 tons.

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PREMIER GOLD MINING has announced that during May 1,814 tons was shipped from the Prosperity mine, near Stewart, B. C., and brought a gross smelter return of $60,498. The net profit of the month's operation was $31,326. Premier owns a 76 per cent interest in the mine. The profits of operation, which to the end of May totaled $124,569, go to Premier until the money it has spent on development and equipment is refunded, after which, 76 per cent will go to Premier, and 24 to the Prosperity Syndicate.

Zinc Production Rate and Stocks Increase

The following is a complete tabulation of zinc statistics for 1929 and 1930, as issued in revised form by the American Zinc Institute:

Slab Zinc Statistics (All Grades), 1929-1930

Tons of 2,000 Lb.

	(1) Stock Beginning of Month	(2) Produced During Month	(3) Total Item (1) Plus Item (2)	(4) Shipped During Month	(5) Stock at End of Month	(6) Shipped for Export	(7)a Retorts Operating End of Month	(8) Unfilled Orders End of Month	(9) Daily Average Produced
1929									
January	45,970	50,501	96,471	49,584	46,887	1,551	63,698	58,726	1,629
February	46,887	47,733	94,620	52,345	42,275	1,014	68,127	59,610	1,705
March	42,275	55,008	97,283	57,963	39,320	1,025	68,015	79,995	1,774
April	39,320	55,203	94,523	58,290	36,233	1,227	70,455	55,571	1,840
May	36,233	57,475	93,708	58,226	35,482	690	70,533	42,883	1,854
June	35,482	52,532	88,014	49,182	38,832	235	69,703	36,127	1,751
July	38,832	54,447	93,279	47,943	45,336	185	69,911	32,031	1,756
August	45,336	55,708	101,044	51,980	49,064	185	59,408	24,283	1,797
September	49,064	51,994	101,058	47,202	53,856	123	69,468	20,270	1,733
October	53,856	54,513	108,369	48,777	59,592	67	67,636	14,844	1,758
November	59,592	48,411	108,003	43,148	64,855	39	58,723	11,872	1,614
December	64,855	47,292	112,147	36,717	75,430	11	57,999	18,585	1,526
Totals		630,817		601,357		6,352			
1930									
January	75,430	52,026	127,456	41,179	86,277	20	59,457	39,017	1,678
February	86,277	44,645	130,922	42,489	88,433	6	57,929	32,962	1,594
March	88,433	48,136	136,569	43,094	93,475	17	51,300	29,330	1,553
April	93,475	44,450	137,925	40,839	97,086	26	50,038	29,203	1,482
May	97,086	44,578	141,664	38,889	102,775	31	52,072	30,515	1,438
June	102,775	43,473	146,248	36,670	109,578	37	52,428	28,979	1,449

Average Retorts Operating During Month a.

1930 January	61,612	April	50,261
February	58,403	May	52,104
March	54,809	June	52,440

a Retort capacity relates only to Prime Western and a small quantity of Brass Special and High-Grade production.

Copper Weaker, But Metals Appear at or Near Bottom of Price Decline

New York, July 17, 1930.—In the last two weeks metal prices have been steady with the exception of copper, which has declined another quarter of a cent, even though buying has been fairly active in recent weeks. Production and stocks of copper, zinc, and tin continue too large, but early improvement is expected, and further important declines in any of the metals seem unlikely. Economists predict a definite upturn in industrial conditions in September, and if this comes about, the metals should share in the improvement. In the meantime, much of the buying will no doubt be of a speculative nature, stimulated by ruling low prices, rather than to cover the requirements of orders actually placed for fabricated material. The ultimate consumer has not yet been attracted much by low prices, but probably will be as soon as they turn upward.

Copper at New Low

The decline of copper prices has been tempered somewhat, the net drop for two weeks being but ¼c., to 11¼c., delivered Connecticut. Rather heavy buying has been witnessed during these two weeks in the domestic market, totaling about 70,000 tons, most of which has been for shipment several months ahead, and up to the end of the year. Large electrical manufacturers have been particularly active in the market; the brass mills have shown less interest. The export market has been dull, the price dropping from 12.30c. some time after the market broke below 12c. here, and the foreign consumers naturally not being willing to pay any unusual premium. The Copper Exporters price was reduced to 11.80c. on July 11, and today has been further reduced to 11.55c., effective tomorrow, July 18. When the export price drops, the large producers come down to a level 0.3c. below for domestic business, and this forces the custom smelters to reduce their prices even lower to sell their intake. This, in time, affects the foreign market and the vicious cycle continues. It will not stop until buying is sufficiently heavy to absorb all the offerings. The statistics issued this month have not been favorable, showing an increase in refined stocks, no change in combined blister and refined, and an actual increase, compared with last March, in the daily rate of world production, even though the June price was only about 12¼c., compared with 18c. in March. Doubtless present prices will be more of a deterrent to production than they were in June, though only a few large producers should actually lose money.

Lead Continues Firm at 5¼c.

Lead has continued unchanged for almost a month at 5¼c., New York, which is the contract price of the American Smelting & Refining Company. The St. Louis market has ruled at 5.15c., though at least one good lot was sold at 5.10c., and slight concessions have been made from usual differentials at some other Mid-Western points. Consumption has shown a definite drop in the last two or three months, but production has also declined, and producers would be willing to see stocks increase considerably before worrying much about the situation. Lead apparently will not suffer the extreme low prices that the other metals have reached, and its market evidently has been handled better, both in this country and in London. Buying has not been for so far ahead as for copper and zinc, only about half of the expected August requirements having been provided for by the middle of July. Corroding grades command the usual premiums of $2@$3 per ton. Low prices for silver and zinc have had an important effect in restricting lead production. Concentrate prices in Joplin are unchanged at $60.

Zinc Holds Above 4c.

Though predictions of 4c. zinc have been rife for weeks, the metal seems to meet real resistance at 4.10c., and the lowest sale reported by the American Zinc Institute in recent weeks was one at 4.05c. In the last week, efforts to buy forward zinc have caused sellers to revise their quotations upward to 4.20c., for August-September shipment, and some zinc has sold as high as 4.25c. Stocks continue to grow, and one can find little optimism among producers, but they are not inclined to reduce prices further unless they have to; so far demand has been fair, and sufficient to absorb the offerings of those who need the cash. The Joplin market for zinc concentrates has been unchanged at $29 for Prime Western grades, and $28 for flotation.

Tin Still Around 30c.

The tin market refuses to drop much below 30c., 29¼c., on July 10, being the low so far for the movement. Fair buying has usually been stimulated below the even figure. Continued reports of curtailments in production have made a slightly stronger market in London, but stocks so far have increased continuously. Futures have sold for premiums of about ⅛c. per month.

Silver Keeps Near 34c.

Silver has been quiet during the last two weeks, with the price slightly above or below 34c. most of the time. At that level it seems to have reached comparative stability for the time being, anyway. Nothing constructive yet seems to have been done for the metal.

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GREAT NORTHERN IRON ORE PROPERTIES, operating in Minnesota, had a consolidated net income, before depletion, of $4,659,184 in 1929. The company distributed $4,875,000, reducing the undivided surplus to $1,274,604.

Current Statistics of Production and Stocks of Copper, Lead, and Zinc

Data from American Bureau of Metal Statistics, American Zinc Institute, and Metallgesellschaft

Figures Represent Tons of 2,000 Lb.

	1929							1930					
	June	July	August	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June
COPPER—North and South America													
Production, refined, daily average	5,215	4,952	4,795	4,478	4,930	4,486	4,458	4,270	4,328	4,099	4,151	4,264	4,161
Domestic shipments	95,258	98,720	96,970	98,043	105,729	68,979	58,150	69,932	61,879	73,644	50,017	75,760	71,887
Foreign shipments	48,461	40,204	45,035	45,921	53,461	37,879	35,652	30,358	29,597	30,523	29,196	49,115	44,818
Stocks, blister and refined	334,621	337,199	346,050	348,270	343,187	385,111	439,726	473,613	497,372	522,581	570,961	573,752	573,293
LEAD—United States													
Production, refined, from domestic ore	Comparative data for 1929 not available, as system of recording was changed recently							49,991	54,125	56,552	55,547	52,818	50,721
Production, secondary and foreign								9,327	6,226	8,600	8,520	6,352	3,965
Production, total, daily rate								1,913	2,155	2,102	2,136	1,909	1,856
Shipments reported								63,954	64,249	65,051	64,100	51,871	50,127
Stocks, end of month								47,756	43,077	42,469	42,015	49,638	55,501
ZINC—United States													
Production, daily average	1,751	1,756	1,797	1,733	1,758	1,614	1,526	1,678	1,594	1,553	1,482	1,438	1,449
Domestic shipments	48,947	47,758	51,795	47,079	48,710	43,109	36,706	41,159	42,483	43,077	40,813	38,858	36,663
Export shipments	235	185	185	123	67	39	11	20	6	17	26	31	37
Stocks, end of month	38,832	45,336	49,064	53,856	59,592	64,855	75,430	86,277	88,433	93,475	97,086	102,775	109,578
World Production Rate (Daily Average)													
Copper	5,820	5,629	5,595	5,805	5,657	5,636	5,346	5,027	5,003	4,805	4,853	4,800	4,852
Lead	5,467	5,277	5,200	5,301	5,494	5,463	5,168	5,032	5,313	5,284	5,109	5,007	.....
Zinc	4,483	4,388	4,397	4,437	4,385	4,365	4,419	4,550	4,660	4,570	4,480	4,303	.....
Tin	575	589	539	580	615	603	615	636	561	495	573	585	.....

Daily Prices of Metals

July	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
3	11.275	30.25	5.25	5.15	4.175@4.20
4	Holiday	Holiday	Holiday	Holiday	Holiday
5	11.275	30.25	5.25	5.15	4.25
7	11.275	30.00	5.25	5.15	4.15@4.25
8	11.275	29.75	5.25	5.15	4.15
9	11.275	29.375	5.25	5.15	4.10
Av'ge	11.275	29.925	5.250	5.150	4.178
10	11.275	29.25	5.25	5.15	4.10@4.20
11	11.275	29.625	5.25	5.15	4.10@4.20
12	11.275	29.625	5.25	5.15	4.15
14	11.275	29.375	5.25	5.15	4.15@4.20
15	11.025	29.50	5.25	5.10@5.15	4.20
16	11.025	30.125	5.25	5.15	4.20
Av'ge	11.192	29.583	5.250	5.146	4.171

Average prices for calendar week ended July 5, 1930, are: Copper 11.450c.; Straits tin, 30.250c.; New York lead, 5.250c.; St. Louis lead, 5.150c.; zinc, 4.160c.; and silver, 33.650c.

Average prices for calendar week ended July 12, 1930, are: Copper, 11.275c.; Straits tin, 29.604c.; New York lead, 5.250c.; St. Louis lead, 5.150c.; zinc, 4.150c.; and silver, 34.271c.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices are quoted on a delivered basis; that is, delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices of refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted.

Quotations for copper are for the ordinary forms or wirebars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight differential. The contract price for High-Grade zinc delivered in the East is 1c. above the St. Louis price for Prime Western.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

Silver, Gold, and Sterling Exchange

July	Sterling Exchange "Checks"	Silver		Gold London	July	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
3	4.86 3/16	33 1/4	15 5/8	85s00 5/8d	10	4.86 1/8	34 1/2	16 1/16	85s00 1/2d
4	Holiday	Holiday	15 5/8	85s00 5/8d	11	4.86 3/16	34 3/4	16 1/8	85s00 3/4d
5	4.86 3/16	33 5/8	15 9/16	.....	12	4.86 1/8	34 3/8	15 15/16	.....
7	4.86 1/4	34	15 1/2	85s00 5/8d	14	4.86 1/8	34 1/2	16	85s00 3/4d
8	4.86 5/16	33 7/8	15 3/4	85s00 3/4d	15	4.86 1/8	34 1/4	15 15/16	85s01 1/4d
9	4.86 5/16	34 1/8	15 13/16	85s00 3/4d	16	4.86 1/4	34	15 13/16	85s01 1/4d

Average of week ended July 9: Silver, 33.875c.; Sterling Exchange, $4.86250.
Average for week ended July 16: Silver, 34.396c.; Sterling Exchange, $4.86156.

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of silver, 999 fine. London silver quotations are in pence per troy ounce of bar silver, basis of 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command nine thirty-seconds cent premium.

London

July	Copper		Electrolytic	Tin		Lead		Zinc	
	Standard								
	Spot	3 M		Spot	3M	Spot	3M	Spot	3M
3	49	48 1/4	54 1/2	136 7/8	138 3/4	17 13/16	17 3/4	15 3/4	16 3/8
4	49	48	54 1/2	135 1/2	137 1/4	18 1/16	17 15/16	16 1/16	16 3/4
7	48 5/8	47 3/4	54 1/2	135	136 3/4	18	17 7/8	15 15/16	16 5/8
8	48 1/4	47 7/8	54 1/2	134 3/8	136 1/4	18	17 7/8	15 3/4	16 3/8
9	47 3/4	47 11/16	53 1/2	133 3/8	135 1/4	18 1/8	17 15/16	15 3/4	16 3/8
10	47 5/8	47 3/8	53 1/2	130 1/4	132 1/8	18 1/8	18	15 5/8	16 1/4
11	47 7/16	47 5/16	52 1/2	133 7/8	135 1/2	18 3/16	18 1/16	15 3/4	16 3/8
14	47 7/16	47 7/16	52 1/2	132 3/4	134 1/2	18 1/8	18 1/16	15 3/4	16 3/8
15	48 1/8	47 15/16	52 1/2	131 3/4	133	18 1/4	18 1/16	15 15/16	16 5/8
16	48 1/8	47 15/16	52 1/2	134 3/8	136	18 3/8	18 2/16	16 1/4	16 15/16

Prices for lead and zinc are the official prices for the morning session of the London Metal Exchange; prices for copper and tin are the official closing buyers' prices. All are in pounds sterling per long ton (2,240 lb.).

Other Metals

Quotations cover wholesale lots, f.o.b. New York, unless otherwise specified. London prices are according to latest mail advices.

ALUMINUM—Per lb., delivered, Alcoa commercial and mill ingot, 99 per cent plus, 23.30c.; Alcoa No. 12 alloy, 22c.; metallurgical ingot, 94 per cent plus, 21.30c. Outside market, 99 per cent, 23.30c.; 98@99 per cent, 22.90c. Market continues quiet with but little interest stimulated by recent 1c. reduction in prices. London unchanged at £95, less 2 per cent, per long ton, for 98 per cent ingots and bars.

ANTIMONY—Per lb., duty paid: Chinese brands, spot and futures, 6¾@6⅞c. Market continues very dull with almost entire absence of carload business. Cookson's "C" grade, spot, 12⅞c. "C.M.C." grade, 99.9 per cent, spot, 10¾c.

BISMUTH—Per lb., in ton lots, $1. London, 4s.

CADMIUM—Per lb., 70c. London, 3s. 5d.

CHROMIUM—Per lb., 97@98 per cent grade, 85@90c.

COBALT—Per lb., delivered: Metal imported from Belgium in the form of rondelles, 97@99 per cent, small lots of spot, $2.50. Discounts on contracts. Quiet. London, spot, 10s.

IRIDIUM—Per oz., $240@$265 for 98 @99 per cent sponge and powder. London, £51½.

MAGNESIUM—Per lb., 12-lb. ingots (4x4x16 in.), 65c.@$1, depending on quantity; 2½- or 3-lb. sticks (1⅜ in.), 70c.@$1.05, depending on quantity. London, 2s. 9d.@3s. for 99 per cent ingots or sticks.

MANGANESE—Per lb. contained manganese, 95@97 per cent, 42c.

NICKEL—Per lb., ingot, 35c.; shot, 36c.; electrolytic, 35c. (99.90 per cent), for single lots of spot metal. Contracts, 30@33c. London, per long ton, £170@£175.

OSMIUM—Per oz., $65@$70. London, £15½.

PALLADIUM — Per oz., $23@$24; sponge, $20. London, £4½.

PLATINUM—Per oz., official price of leading interest reduced from $46 to $43 on July 9. Cash transactions between dealers and refiners at several dollars less. Average price for platinum content of crude platinum in June was $38@$40. Market for all precious metals very slow. London, per oz., £8⅜.

QUICKSILVER—Per 76-lb. flask, $117 @$119, though asking price about $120 for small lots. London slow at £22⅝.

RADIUM—Per mg. radium content, $50 in lots of 4 grams or more, to $65 for 1 gram.

RHODIUM—Per oz. $50@$55. London, £11.

RUTHENIUM — Per oz., $40@$42. London, £9½.

SELENIUM—Per lb., $1.80@$2, depending on quantity, for black, pow-

dered, 99.5 per cent pure. London, 7s. 8d.

SILICON—Per lb., 97 per cent, 15@17c.

TANTALUM—Per kilo, $128 for C.P. sheet. Slow.

TELLURIUM—Per lb., $2.

TUNGSTEN—Per lb. contained tungsten, 98 per cent, powdered, $1.55@$1.60. Slow.

Metallic Ores

Prices in tons of 2,000 lb., or in "units" of 20 lb., unless otherwise stated.

ANTIMONY ORE—Per unit, Bolivian ore, 60 per cent metallic antimony, $1.15, c.i.f. New York. London, per long ton unit, 3@4s. for 60 per cent sulphide ore.

BERYLLIUM ORE—Per unit of BeO, minimum 10 per cent BeO, $5@$8, f.o.b. mines.

CHROME ORE—Per long ton, f.o.b. Eastern shipping points, Indian and Rhodesian ores, $20 for 46@47 per cent Cr_2O_3 ore, and $24 for 50@51 per cent ore. London, £4½ for 48 per cent Rhodesian, and £4¼@£5¼ for Indian and New Caledonian.

IRON ORE—Per long ton, Lower Lake ports. Lake Superior ores:

Mesabi, non-bessemer, 51½ per cent iron, $4.50. Old Range, non-bessemer, $4.65.

Mesabi, bessemer, 51½ per cent iron, $4.65. Old Range, bessemer, 51½ per cent, $4.80.

Eastern ores, cents per unit, delivered at furnaces: Foundry and basic, 56 to 63 per cent, 10c.

Foreign ores, alongside docks Atlantic ports, cargo lots, cents per unit:

North African and Swedish, low-phosphorus, 10½@11c.

Spanish and North African basic, 50@60 per cent, 9½@10c.

Swedish foundry or basic, 66@68 per cent, 10c.

Newfoundland foundry, 55 per cent, 9c. Nominal.

MANGANESE ORE—Per long ton unit of Mn, c.i.f. North Atlantic ports, cargo lots, exclusive of duty: Brazilian, 46@48 per cent Mn, 28c.; Indian, 48@50 per cent, 30c.; Caucasian, 52@55 per cent, 30c.; South African, 52@54 per cent, 28@29c., nominal.

Per ton in carload lots:

Chemical grades, powdered, coarse or fine, minimum 80 per cent MnO_2, Brazilian or Cuban, $60. Javan or Caucasian, 85 per cent minimum, $65. Domestic, 70 to 72 per cent, $40@$50, f.o.b. mines.

MOLYBDENUM ORE—Per lb. of contained MoS_2, United States market entirely nominal at 50@55c. London, per long ton unit, nominal at 32s. 6d. for 80@85 per cent concentrate.

TANTALUM ORE—Per lb. Ta_2O_5, $1.40 for 60 per cent ore. Per lb., f.o.b. *New Mexico* mines, crude ore with minimum 40 per cent Ta_2O_5, 40c. Good demand.

TIN ORE—No market in United States. London, returning charge on 60 per cent Bolivian, £10 per long ton; on 70 per cent Nigerian, £5⅝.

TITANIUM ORE — Per gross ton, ilmenite, 45@52 per cent TiO_2, f.o.b. Atlantic seaboard, $10@$12, according to grade and impurities. Low-grade domestic, 32 to 35 per cent, about $7@$8. Rutile, per lb., guaranteed minimum 94 per cent concentrate, 10c. in carload lots.

TUNGSTEN ORE—Per unit of WO_3, N. Y.: Wolframite, nominally $12.50@$13, duty paid. Bolivian scheelite, $13@$13.50, and domestic scheelite, $14; both nominal.

VANADIUM ORE—Per lb. V_2O_5 contained, 28c. Active.

ZIRCON ORE—Per ton, 55 per cent ZrO_2, f.o.b. Atlantic seaboard, $40@$45 in 30-ton lots.

Non-Metallic Minerals

Prices received for non-metallic minerals vary widely and depend upon the physical and chemical characteristics of the commodity. Hence the following quotations can serve only as a general guide to the prices obtained by producers and dealers in different parts of the United States for their own product. In the last analysis the value of a particular non-metallic mineral can be ascertained only by direct negotiation between buyer and seller.

Tons of 2,000 lb. unless otherwise noted.

[1]AMBLYGONITE — Per ton, f.o.b. mines, 8@9 per cent lithium oxide, $50@$60.

ASBESTOS—Per ton, f.o.b. Quebec mines, tax and bags included: Crude No. 1, $475@$575; crude No. 2, $325@$375; spinning fibers, $150@$175; magnesia and compressed sheet fibers, $100@$135; shingle stock, $50@$85; various grades paper stock, $35@$40; cement stock, $15@$25; floats, $12@$15.

Per ton c.i.f. New York: Rhodesian crude No. 1, $350; No. 2, $275.

BARIUM CARBONATE (Witherite)—Per ton: 90 per cent, 200 mesh, $47; 100 mesh, $44.

BARYTES—F.o.b. mines, bags extra:

Georgia: Barytes ore, crude, $6.50 per ton; poor demand, with foreign competition. Washed, 93 per cent $BaSO_4$, $7 per long ton.

Missouri: Water ground and floated, bleached, $23, car lots, f.o.b. works. Crude ore, 93 per cent $BaSO_4$, not to exceed 1 per cent iron, $7.75 per ton, f.o.b. mines.

BAUXITE—Per long ton: Domestic ore, chemical, crushed and dried, 55 to 58 per cent Al_2O_3, 1.5 to 2.5 per cent Fe_2O_3, $7@$8.25, f.o.b. *Alabama* and *Arkansas* mines. Other grades, 56 to 59 per cent Al_2O_3, 5 to 8 per cent SiO_2, $6.50@$8, f.o.b. *Arkansas* mines. Pulverized and dried, 56 to 59 per cent Al_2O_3, 8 to 12 per cent SiO_2, $12@$12.25, f.o.b. *Arkansas* mines, abrasive grade, crushed and calcined, 78 to 84 per cent, Al_2O_3, $15@$17.50, f.o.b. *Arkansas* mines.

[1]Price furnished by Foote Mineral Company, Philadelphia.

Per metric ton, foreign, c.i.f. Atlantic ports: Dalmatian, 50 to 55 per cent Al_2O_3, 1 to 3 per cent SiO_2, $4.50@$6.50; Istrian, 54 to 57 per cent Al_2O_3, 3 to 5 per cent SiO_2, $5.50@$7; French, 56 to 59 per cent Al_2O_3, 2 to 4 per cent SiO_2, $6@$8; 56 per cent Al_2O_3, 1.50 per cent SiO_2, $7; 58 per cent Al_2O_3, 3@4 per cent SiO_2, $6.50.

BORAX—Per ton, carload lots, in bags, crystals, $56; granulated, $50; powdered, $57.50; f.o.b. shipping point.

[1]CELESTITE—Per ton in carload lots: 90 per cent $SrSO_4$, finely powdered, $27.

CHINA CLAY (KAOLIN) — Per ton: F.o.b. *South Carolina* mines, crude lump, No. 1, $5@$6; pulverized, $8@$12.

Florida, pressed pottery, bulk, $13; ground, No. 1, $20; No. 2, $15. Sprayed mineral flour in 100-lb. bags (bags extra), No. 1, $20; No. 2, $17.

Imported English, f.o.b. American ports; lump, $14@$20. Market fair and quiet.

EMERY—F.o.b. *New York*, crude ore, per ton, $10. Market normal. F.o.b. *Pennsylvania*, in 350-lb. kegs, Turkish, Khasia, and Naxos emery, 6½c. per lb.; American, 3½c. Small demand.

FELDSPAR—Per ton, ground: Canada, $22.50; New England, $22; Southern, $20; Trenton, $25; Western, $24.

FLUORSPAR—Per ton, f.o.b. *Kentucky* and *Illinois* mines:

Gravel, not less than 85 per cent CaF_2, and not over 5 per cent SiO_2, $18. Foundry lump, 85-5, $20. Ground, 95 to 98 per cent CaF_2, and not over 2½ per cent SiO_2, $32.50 in bulk; $36.50 in bags or barrels. Market quiet but hopeful of better prices under new tariff of $7.50 per ton when containing less than 97 per cent CaF_2. If over 97 per cent, the old $5 rate applies.

GARNET—Per ton, f.o.b. *New Hampshire* mines: crude or mill run, $40; unwashed grades, $80; washed, $125.

New York: Adirondack garnet, $85. Very quiet.

Spanish grades, $60, c.i.f. port of entry.

GILSONITE—Per ton, carload lots, f.o.b. mines *Colorado:*

Selected grade, $33; seconds (mine run), $25.50. Market normal.

GRAPHITE—Per lb., f.o.b. *New York:*

Ceylon lump, 8@9c.; chip, 6½@7½c.; dust, 3@5c.; Madagascar flake, 6½@8½c.

No. 1 flake, 8@16c.; fine ground, 5c. upward; amorphous, 3c. upward. Very limited demand and highly competitive. New tariff carries unchanged duty of 10 per cent on amorphous; 30 instead of 20 on crystalline; and 1.65c. per lb. instead of 1.5c. on flake.

Crude amorphous graphite, $15@$35 per ton, according to grade. Quiet.

GREENSAND—Per ton, f.o.b. cars, *New Jersey:* Screened and bagged, best grade, in carload lots, $20. Fair, with prospects for good business.

GYPSUM—Per ton, f.o.b. mill, depending upon location: Crushed, $1.50 @$3; ground, $4@$7; agricultural, $4@$7; calcined, $4@$9.

IRON OXIDE (See Ocher)—Per lb.: Standard Spanish red, 3@4½c.; domestic earth, 2@4½c.

KAOLIN—See China Clay.

LEPIDOLITE—Per ton, $20@$30 for ordinary grades. Nominal.

LIMESTONE—Per ton: f.o.b. shipping points, depending on location, either lump or crushed, 25c.@$1.75.

Agricultural, 75c. up to $6 for crushed or pulverized. Prices depend upon source, purity, and fineness.

MAGNESITE—Per ton, f.o.b. *California* steel mill points: dead-burned, $29. Market about 60 per cent of normal. *Washington:* Dead-burned grain magnesite, $22. Market below average.

MICA—F.o.b. *New Mexico* mines, waste and scrap, $15 per ton; punch, 6c. per lb.; sheet, 18c.@$4.50 per lb., according to size. Fair demand for scrap and good market for sheet and punch.

MONAZITE—Per ton, minimum 6 per cent ThO_2, $60.

OCHER—F.o.b. *Georgia* mines, per ton: $17.50 in sacks; $20, barrels; second grade, $10. Moderate demand. Buff clay, 98 per cent through 325 mesh, $18.

PHOSPHATE—Per long ton, f.a.s. or f.o.b. mines:

Florida, pebble, f.a.s., for export: 76@77 per cent, $7.15; 75 per cent, $6.40; 74@75 per cent, $6.15; 70 per cent, $4.65; 68 per cent, $4.10. Firm.

Florida, pebble, domestic: 76@77 per cent, $6.50; 74@75 per cent, $5.50; 72 per cent, $4.50; 70 per cent $4. Dull.

Tennessee, ground, 80 per cent through 300 mesh, 33 per cent P_2O_5, $11.80 per short ton.

POTASH—Per ton, contracts:

	Bags	Bulk
Muriate of potash, 80@85 per cent, basis 80 per cent	$37.15	$35.55
Sulphate of potash, 90@95 per cent, basis 90 per cent	48.25	46.65
Sulphate of potash-magnesia, 48@53 per cent, basis 43 per cent	27.80	26.20
Manure salt, 30 per cent	22.15	19.15
Manure salt, 20 per cent	15.65	12.65
Kainit, 14 per cent	12.70	9.70

PUMICE STONE—Per lb., in barrels, powdered, 2½@4c.; selected lump, 5@7c.

PYRITES—Per long ton unit of sulphur; c.i.f. United States ports; guaranteed 48 per cent sulphur, Spanish, 13c.

QUARTZ ROCK CRYSTALS—Per lb. in ton lots: Colorless, clear but flawed, pieces ¼ to ½ lb. in weight, 20c. Flawless, for optical purposes, four times above price; larger crystals still higher.

SILICA—per ton: Water ground and floated, in bags, f.o.b. Illinois: 325 mesh, $16@$40 for 92 to 99½ per cent grades. Market steady. Glass sand, f.o.b. producing plant, $1.25@$5 per ton; molding sand, 50c.@$3.50; blast sand, $1.75 @$6.

SPODUMENE — Per ton: $20@$30, depending upon lithium content.

SULPHUR—Per long ton for domestic market, $18 f.o.b. Texas mines; $22 for export, Atlantic ports.

TALC—Per ton, carload lots, f.o.b, works, containers included unless otherwise specified:

Vermont: 99 per cent through 200 mesh, extra white, bulk basis, $8@$8.50; 97 to 98 per cent through 200 mesh, medium white, $7.50@$8. Packing in paper bags, $1 per ton extra. Demand against contracts very light.

New York: Double air-floated, short fiber, 200 mesh, $13.75; 325 mesh, $14.75.

New Jersey: Soapstone, ground, $10 @$12. Market poor.

TRIPOLI—Per short ton, burlap bags, paper liners, minimum carload 30 tons, f.o.b. *Missouri:* Once ground through 40 mesh, rose and cream colored, $16. Double ground through 110 mesh, rose and cream, $18. Air-floated through 200 mesh, rose and cream, $27.50; mill run, $16. Usual quiet summer period. Business for first half 1930 was 70 per cent of same 1929 period but 90 per cent of 1928.

Rolled Metals

COPPER — Sheets, hot-rolled, per lb., 21¼c.; wire, per lb., f.o.b. mill, 13c.

LEAD SHEETS—Full rolled, 8c. per lb.; clipped, 8¼c.

MONEL METAL—Per lb., sheets, full finished, 42c.; rods, hot-rolled, 35c.

NICKEL—Per lb., sheets, full finished, 52c.; rods, hot-rolled, 45c.

ZINC SHEETS—Per lb., 9½c., f.o.b. works; ribbon, 9c.; 7 per cent discount on orders for 18 tons or more.

Alloys

FERROCHROME—Per lb. of contained chromium, 4 to 6 per cent carbon, 11c., delivered, on contracts; spot, 11½c. Containing 2 per cent carbon, 17½c.; 0.10 per cent carbon, 26c.

FERROMANGANESE — Per gross ton furnace: Domestic and foreign, 78@82 per cent, $94@$99. Spiegeleisen, 19@ 21 per cent, $34 on carload business.

FERROMOLYBDENUM—Per lb. of Mo, f.o.b. shipping point, 50@60 per cent Mo, $1.15.

FERROPHOSPHORUS—Per ton, 18 per cent P, $91; electrolytic, 24 per cent, $122.50, f.o.b. *Alabama* and *Tennessee.*

FERROSILICON—Per gross ton, delivered, 50 per cent, $83.50; 75 per cent, $130; 14@16 per cent, $39, f.o.b. Suspension Bridge, N. Y. Spot shipments $5@$10 per ton higher on 50 and 75 per cent grades.

FERROCARBONTITANIUM — Per ton: $160, f.o.b. producer's plant.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent W, $1.20@$1.25 f.o.b. works.

FERROVANADIUM—Per lb. of V contained, delivered, $3.15@$3.50.

MUNTZ METAL—Rods, 18c.; plates, 20¾c.

NICKEL SILVER—Per lb., sheets, 10 per cent, 25½@26c.; 18 per cent, 28¾@ 29¼c. Wire and rods, 10 per cent, 29c.; 15 per cent, 32¾c.; 18 per cent 36½c.

PHOSPHOR BRONZE—Per lb., sheets and rods, 5 per cent tin, 32½c.; wire, 5 per cent, 33c.; 10 per cent, 38½c.

PHOSPHOR BRONZE—Sheets and rods, 5 per cent tin, 32½c. Wire, 5 per cent, 33c.; 10 per cent, 38½c.

SILICON ZIRCONIUM—Per lb., 47@52 per cent Si, 35@40 per cent Zr, 18@21c.

ZIRCONIUM FERROSILICON—Per gross ton, 12@15 per cent Zr, 39@43 per cent Si, $103.50@$108.50.

Metallic Compounds

ARSENIOUS OXIDE (White arsenic)—Per lb., 4c., delivered, all positions. Steady and unchanged. London, per long ton, £15¾ for Cornish white.

CALCIUM MOLYBDATE OR MOLYTE—Per lb. of contained Mo, 95c. Business about 20 per cent less than 1929 but better than 1928.

COBALT OXIDE—Per lb., black, 70@71 per cent contained Co, $2.10. Slightly below normal volume of business. London, 8s. for black; 8s. 10d. for gray.

COPPER SULPHATE (Blue Vitriol)—Per lb., in car lots, 4¾c. for either large or small crystals. Record demand towards close of the season.

SODIUM NITRATE—Per 100 lb.; crude natural, in bags ex vessel, Atlantic ports, $2.07@$2.10 for spot.

SODIUM SULPHATE (Salt Cake)—Per ton, bulk, f.o.b. works, $18@$20.

ZINC OXIDE—Per lb. in bags, in car lots: Lead-free, 6½c.; 10, 20 or 35 per cent leaded grades, 6¼c.; French red seal, in bags, 9⅜c.

Refractories

CHROME BRICK—Per ton, f.o.b. shipping point, $45.

FIRECLAY BRICK — Per M.: First quality, $43, *Ohio, Kentucky, Central Pennsylvania;* second quality, $35@$38.

MAGNESITE — Brick, per ton, f.o.b. work: 9-in. straights, $65, f.o.b. plant. Dead-burned grain, $40, f.o.b. Chester, Pa., or Baltimore.

SILICA BRICK—Per M., *Pennsylvania,* $43; *Alabama,* $50@$51; *Illinois* and *Indiana,* $52.

ZIRKITE—Per lb.: Powdered, 65@70 per cent ZrO_2, 3½c. Brick, straights, 80c.@$1 each.

Iron, Steel, and Coke

IRON—Per gross ton, Valley furnaces: Bessemer, $18.50; basic and No. 2 foundry, $18; prices slightly lower.

STEEL—Base prices per gross ton, Pittsburgh, billets and slabs, $31; plates and structural shapes per 100 lb., $1.65 @$1.70; soft steel bars, $1.70@$1.75.

COKE—Per gross ton, Connellsville furnace, $2.50. Connellsville foundry, $3.50@$4.85. Byproduct coke, Ohio and Kentucky (Connellsville basis), $6.50; Buffalo and Detroit, $8.50.